

QUALITY ASSURANCE SAMPLING PLAN
FOR
EXPANDED SITE INSPECTION
JACKPILE-PAGUATE URANIUM MINE
SR 279 LAGUNA PUEBLO
PAGUATE, CIBOLA COUNTY, NEW MEXICO

Prepared for

U.S. Environmental Protection Agency Region 6

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1. INTRODUCTION

Weston Solutions, Inc. (WESTON®), the EPA Region 6 Superfund Technical Assessment and Response Team (START-3) contractor, has been tasked by the U.S. Environmental Protection Agency (EPA) Region 6 Prevention and Response Branch (PRB) under Contract No. EP-W-06-042 and Technical Direction Document (TDD) No. TO-0019-10-11-1 (Appendix E) to perform Expanded Site Investigation (ESI) activities at the Jackpile-Paguate Uranium Mine site located on SR 279 Laguna Pueblo in Paguate, Cibola County, New Mexico. A Site Location Map is provided as Figure 1-1. The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database number assigned to the Jackpile-Paguate Uranium Mine Site is NMN000607033. START-3 has prepared this Quality Assurance Sampling Plan (QASP) to describe the technical scope of work (SOW) to be completed as part of the ESI.

1.1 PROJECT OBJECTIVES

START-3 is providing technical assistance to EPA Region 6 for the performance of an ESI at the Jackpile-Paguate Uranium Mine site. The objective of the ESI is to identify potential threats that hazardous substances attributable to the site may pose to human health and the environment. START-3 will assess the existence and migration of hazardous substances and identify the receptors, or targets, potentially exposed to the hazardous substances.

The ESI objective will be achieved by evaluating data obtained during the 2010 Site Inspection (SI), along with new analytical data from surface water and groundwater samples collected at on-site, downgradient, and background locations. Sediment samples in the surface water pathway may also be collected during this ESI. The site-specific Contaminants of Concern (CoCs) include isotopic uranium, total metals (including mercury), gross alpha, beta, and gamma, and radium 226 + 228. The site-specific screening levels will be identified as three times the maximum background sample concentrations.

In addition, water samples will be analyzed for total dissolved solids and general cation/anion chemistry. These data will be used to evaluate sample locations with a conceptual site model that considers hydrologic and hydrochemical data.

The information collected by START-3 during the ESI will be used to evaluate the site using the Hazard Ranking System (HRS) and to assist in determining whether the site is a potential candidate for inclusion on the National Priorities List (NPL). The intent of the ESI is to provide documentation necessary to either rank the site on the NPL or assign a “No Further Remedial Action Planned” (NFRAP) status.

1.2 PROJECT TEAM

The Project Team will consist of START-3 personnel including Michelle Brown as the Project Team Leader (PTL), a Field Safety Officer (FSO), a Data Manager, and additional START-3 Field Team Members to assist with sampling activities. The PTL will oversee collection of the samples as necessary, record the activities at each sample location in the field logbook, and verify sample documentation. Sample documentation and preparation is also the responsibility of START-3. The PTL will be responsible for documenting the work performed and will serve as START-3 liaison to EPA Region 6.

1.3 QASP FORMAT

This QASP has been organized in a format that is intended to facilitate and effectively meet the objective of the removal assessment. The QASP is organized as follows:

- Section 1 – Introduction
- Section 2 – Site Background
- Section 3 – Sampling Approach and Procedures
- Section 4 – Analytical Methods
- Section 5 – Data Validation
- Section 6 – Quality Assurance

Tables are included at the end of each representative section. All figures are provided as separate Portable Document Format (PDF) files. Appendices are attached with the following information:

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Appendix A	EPA Contract Laboratory Program Guidance for Field Samplers
Appendix B	Site-Specific Data Quality Objectives
Appendix C	WESTON and ERT Standard Operating Procedures
Appendix D	Laboratory Analyte List and Reporting Limits
Appendix E	START-3 TDD No. TO-0019-10-11-1

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2. SITE BACKGROUND

Information regarding the site location, description, and site history are included in the following subsections.

2.1 SITE LOCATION AND DESCRIPTION

The Jackpile-Paguate Uranium Mine site consists of approximately 7,868 acres of uranium mine leases within the Pueblo of Laguna, Paguate, Cibola County, New Mexico. The site is located 40 miles west of Albuquerque, New Mexico and contains 2,656 acres of disturbed land that consists of three open pits and nine underground mines. The geographical center of the site is Latitude 35°8'16.74" North and Longitude 107°20'51.84" West. A Site Area Map derived from the ESRI geographical information system (GIS) Microsoft Virtual Earth Roads, 2009 is included as Figure 2-1.

The village of Paguate is located adjacent and west of the site with a population of approximately 474 according to the 2000 U.S. Census. The remaining surrounding area is mainly undeveloped, with the perennial rivers Rio Moquino and Rio Paguate bisecting the site. The Rio Paguate continues south of the former uranium mine continuing through the Paguate Reservoir, 4 miles south of the site, into the Rio San Jose.

2.2 SITE HISTORY

The mine was operated by Anaconda Minerals Company, a division of the Atlantic Richfield Company, from 1953 through 31 March 1982. The mine was closed because of a sustained fall in the price and demand for uranium.

During its operation, open pit mining was conducted with large front-end loaders and haul trucks. The overburden, consisting of topsoil, alluvium, shale, and sandstone, was blasted or ripped, removed from the open pits, and placed in waste dumps. Underground mining was conducted by driving adits, or declines, to the ore zone. The ore was removed by modified room and pillar methods. Mine water was collected in sumps and pumped to ponds in the open pits.

Waste rock was placed in waste dumps. The ore was segregated and shipped by rail to the Anaconda mill, 40 miles west of the mine.

During the 29 years of mining, approximately 400 million tons of earth was moved within the mine area, and about 25 million tons of ore was removed.

3. SAMPLING APPROACH AND PROCEDURES

The specific field investigation activities that will be conducted during site sampling are presented in the following subsections. Samples collected as part of this ESI will be obtained in accordance with EPA *Contract Laboratory Program Guidance for Field Samplers, EPA540-R-00-003, OSWER 9240.0-35* (Appendix A).

3.1 OVERVIEW OF MONITORING/SAMPLING ACTIVITIES

This ESI is being performed to evaluate the surface water and groundwater-to-surface water exposure pathways at or near the Jackpile-Paguate Uranium Mine site. The primary CoCs at the site are uranium, gross alpha, beta, and gamma (which includes thorium), radium 226+228, and heavy metals. Subcontracted laboratories will be utilized for analysis of isotopic uranium; total metals (including mercury); gross alpha, beta, and gamma; and radium 226+228.

In addition, water samples will be analyzed for total dissolved solids (TDS) and general cation/anion chemistry. These data will be used to evaluate the samples in the context of the site hydrologic model.

The EPA SAM and START-3 will collect 11 (including duplicates) surface water samples from Rios Paguate and Moquino, and 14 (including duplicates) groundwater samples from existing wells around the site. START-3 will also collect ten sediment samples from the surface water pathways that include the Rio Moquino, Rio Paguate, Paguate Reservoir, and the Rio San Jose (including background and Quality Assurance/Quality Control [QA/QC]). If necessary, sampling of investigation-derived waste (IDW) will be performed to properly dispose of IDW. START-3 will use EPA Scribe Environmental Sampling Data Management System (SCRIBE) software to manage sample data.

3.1.1 Data Quality Objectives

The objectives of the sampling activities described in this QASP are to collect representative surface water and groundwater samples to determine if there has been a release of site-related hazardous substances and contaminants into the surface water and groundwater pathways. To

accomplish this, the following data quality objectives (DQOs) have been established and are included in Appendix B:

- Determine if there is a release of site-related contamination in the groundwater pathway.
- Determine if there is a release of site-related contamination in the surface water pathway.
- Provide water chemistry data to support hydrologic model.

The DQOs were developed using the seven-step process set out in the *EPA Guidance for Quality Assurance Project Plans: EPA QA/G-5*. Table 3-1 summarizes the sample locations and the rationale for their collection.

3.1.2 Health and Safety Plan Implementation

The START-3 field activities will be conducted in accordance with the site-specific health and safety plan (HASP). The FSO will be responsible for implementation of the HASP during all field investigation activities. In accordance with the WESTON general health and safety operating procedures, the field team will also drive the route to the hospital specified in the HASP prior to initiating sampling activities. Radiation monitoring will be conducted at all sample locations prior to and during sample collection using a MicroR meter.

3.1.3 Tribal Involvement

The EPA SAM will coordinate all assessment activities with the Pueblo of Laguna Environment Department. Any issues will be directed to the EPA SAM. If the EPA SAM is not present, the START-3 PTL, under the guidance of the START-3 Assessment/Inspection Manager, will manage tribal involvement in the field as directed by the SAM. If a tribal involvement plan and implementation program becomes necessary, START-3 will establish each if requested by the EPA SAM. START-3 will work as directed by the EPA SAM to obtain access to all designated sampling locations.

3.2 SAMPLING/MONITORING APPROACH

All samples will be collected in general accordance with the WESTON Standard Operating Procedures (SOPs) 1002-01 for Surface Water Sample Collection, 1002-02 for Groundwater

Monitoring Well Sample Collection, and 1002-04 for Sediment Sampling (Appendix C). The specific sampling procedures are described below.

3.2.1 Groundwater Pathway Sampling

Fourteen groundwater samples (including two duplicates) will be collected from existing monitoring wells. START-3 will measure depth to groundwater in each of the wells and then follow the EPA *Guidance for Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures* (Appendix D) for sampling the wells, if appropriate. START-3 anticipates using either a Smeal rig, QED pneumatic pump or peristaltic pump depending on the depth to groundwater. Readings for temperature, pH, and conductivity will be collected every 5 minutes. Once three consecutive readings stabilize for pH (± 0.5 units), conductivity ($\pm 10\%$ $\mu\text{mhos/cm}$), and temperature ($\pm 1^\circ\text{C}$), or the water has purged for a maximum of 30 minutes, the samples will be collected.

The exact number of samples and locations of the samples will be decided by the EPA SAM and START-3 PTL. The proposed groundwater sample locations are presented in Figure 3-1.

The groundwater samples will be submitted to a National Environmental Laboratory Accreditation Program (NELAP) certified laboratory, for the following analyses:

- Isotopic Uranium (including isotopes 234, 235, and 238) by ASTM 3972-90M alpha spectrometry.
- Total metals including mercury by SW846 Methods 6010B and 7470/7471.
- Gross alpha, beta, and gamma (which include thorium) radiation by EPA Method 9310.
- Radium 226 and 228 by EPA Method 903.1.
- Total Dissolved Solids (TDS) by EPA Method 160.1
- General Anion Chemistry by EPA Method 9056. The laboratory will also calculate total alkalinity and carbonate and bicarbonate calculations.

Laboratory-specific analyte lists and reporting limits are included in Appendix D. Deviations from the sample locations may occur at the EPA SAM's direction, due to new observations made prior to sampling, information obtained in the field that warrants an altered sampling point,

difficulty in sample collection, or limited access. The EPA SAM will be notified, and concurrence will be obtained should significant deviations from the planned sampling points be proposed. Details regarding deviations of the QASP will be documented in the site logbook.

3.2.2 Surface Water Pathway Sampling

START-3 will collect 11 surface water, and 10 sediment samples (including two background and one duplicate sample) as part of the ESI to document a release to the surface water pathway from the site. The proposed surface water and/or sediment sample locations are presented in Figure 3-1.

Surface water and sediment samples will be submitted to a NELAP certified laboratory to be determined for the following analyses:

- Isotopic Uranium (including isotopes 234, 235, and 238) by ASTM 3972-90M alpha spectrometry.
- Total metals including mercury by SW846 Methods 6010B and 7470/7471, respectively.
- Gross alpha, beta, and gamma (including thorium) radiation by EPA Method 9310.
- Radium 226 +228 by EPA Method 903.1.

In addition, surface water samples will be analyzed for the following:

- Total Dissolved Solids (TDS) by EPA Method 160.1
- General Anion Chemistry by EPA Method 9056. The laboratory will also calculate total alkalinity and carbonate and bicarbonate calculations.

The laboratory-specific analyte list and reporting limits are included in Appendix D.

3.2.3 Investigation-Derived Wastes

Attempts will be made to eliminate or minimize generation of IDW during this investigation. All non-dedicated equipment will be decontaminated according to WESTON SOP 1201.01. Non-dedicated equipment will be rinsed with soap and water and attempts will be made to dispose of decontamination fluids and purge waters on-site. The analytical data from collected samples will be reviewed after completion of the field activities, and disposal options will be evaluated

accordingly. It is anticipated that minimal amounts of IDW will be generated during this activity.

3.2.4 Sampling and Sample Handling Procedures

Samples will be collected using equipment and procedures appropriate to the matrix, parameters, and sampling objectives. All water samples collected will be field filtered using 0.45µ filter paper according to EPA Emergency Response Team (ERT) SOP #2007 (Appendix C). The volume of the sample collected must be sufficient to perform the laboratory analysis requested. Samples must be stored in the proper types of containers and preserved in a manner appropriate to the analysis to be performed. A sample collection and analyses summary table is presented in Section 4.

All clean, decontaminated sampling equipment and sample containers will be maintained in a clean, segregated area. All samples will be collected with clean decontaminated equipment following WESTON SOP 1201.01. All samples collected for laboratory analysis will be placed directly into pre-cleaned, unused glass or plastic containers. Sampling personnel will change gloves between each sample collection/handling. All samples will be assembled and catalogued prior to shipping to the designated laboratory (following WESTON SOP 1101.1 and 1102.01).

3.2.5 Quality Assurance/Quality Control Samples

START-3 will collect field duplicate and Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples of groundwater, surface water, and solid-matrix samples, as well as prepare equipment rinsate blank samples as needed during the assessment sampling activities. QA/QC samples will be collected according to the following dictates:

- Blind field duplicate samples will be collected during sampling activities at locations selected by the START-3 PTL. The data obtained from these samples will be used to assist in the quality assurance of the sampling procedures and laboratory analytical data by allowing an evaluation of reproducibility of results. Efforts will be made to collect duplicate samples in locations where there is visual evidence of contamination or where contamination is suspected. Blind field duplicate samples will be collected at the rate of one duplicate for every 10 samples collected.
- Equipment rinsate blanks will be prepared by pouring laboratory-grade deionized water over nondisposable sampling equipment after it has been decontaminated and collecting the rinse

water in sample containers for analyses. These samples will be prepared to demonstrate that the equipment decontamination procedures for the sampling equipment were performed effectively. The equipment rinsate blanks will be prepared each day that non-disposable sampling equipment is used.

- Temperature blanks will be prepared in the field and will consist of one 40-milliliter glass sample container with Teflon-lined septum cap. The temperature blank will be packaged along with the field samples in the shipping cooler and will represent the temperature of the incoming cooler upon receipt at the laboratory. Use of these samples within a shipping container enables the laboratory to assess the temperature of the shipment without disturbing any of the field samples.
- MS/MSD samples will be collected during sampling activities at locations selected by the START-3 PTL. The data obtained from these samples will be used to assist in the quality assurance of the sampling procedures and laboratory analytical data by allowing an evaluation of reproducibility of results. Efforts will be made to collect MS/MSD samples in locations where there is no visual evidence of contamination or where contamination is not suspected. MS/MSD samples will be collected at the rate of one MS/MSD sample per matrix for every 20 samples collected.

3.3 SAMPLE MANAGEMENT

Specific nomenclature that will be used by START-3 will provide a consistent means of facilitating the sampling and overall data management for the project (WESTON SOP 0110.05). The START-3 Assessment/Inspection Manager must approve any deviations from the sample nomenclature proposed below.

As stated in WESTON SOP 0110.05, sample nomenclature will follow a general format regardless of the type or location of the sample collected. The general nomenclature consists of the following components:

- Geographic location (e.g., location within a surface water body or monitoring well).
- Collection type (composite, grab, etc.).
- QA/QC type (normal, duplicate, etc.).
- Sequence - An additional parameter used to further differentiate samples.

Sample data management will be completed utilizing SCRIBE including Chain-of-Custody (COC) and sample documentation needs.

3.4 DECONTAMINATION

The nondisposable sampling equipment (hand trowels, stainless steel bowls, etc.) used during the sample collection process will be thoroughly decontaminated before initial use, between use, and at the end of the field investigation. Equipment decontamination will be completed in the following steps:

- Water spray or brush, if needed, to remove soil/sediment from the equipment.
- Nonphosphate detergent and potable water wash to clean the equipment.
- Final potable water rinse.
- Air-dried equipment.

Personnel decontamination procedures are described in the site-specific HASP. All decontamination activities will be conducted at a temporary decontamination pad that will be constructed in an area to be determined by the PTL prior to the beginning of field activities.

Excess soil and fluids generated as a result of equipment decontamination will be placed in a drum and staged in an area to be determined by the PTL. The drum will be labelled on the side with the name of the site, the contents, sampling location, and date.

3.5 SAMPLE PRESERVATION, CONTAINERS, AND HOLD TIMES

Once collected, samples will be stored in coolers on-site until shipped for laboratory analysis. Samples designated for alpha spectrometry analysis do not require maintenance of a specific temperature range and do not have a holding time limit. Chain-of-custody forms will be completed for each sample shipment and sent with the samples to the designated laboratory by overnight carrier.

START-3 will receive analytical results based on discussions with the EPA SAM. This turnaround time (TAT) is initiated when the samples are received by the laboratory and continues until the analytical results are made available to START-3 either verbally or by providing facsimile or email copies of the results for review. Samples that have been analyzed will be disposed by the designated laboratory in accordance with the laboratory SOPs.

Table 3-1
Sample Locations and Sampling Rationale
Jackpile-Paguate Uranium Mine
Paguate, Cibola County, New Mexico

Sample Name	Sample Matrix	Sample Location (refer to Figure 3-1)	Rationale
RM-SW-BG-(date) RM-SED-BG-(date)	Surface water Sediment	Rio Moquino upstream of Jackpile Mine	Previous sample location. Collected to establish background concentration on Rio Moquino.
RP-SW-BG-(date) RP-SED-BG-(date)	Surface water Sediment	Rio Paguate upstream of Jackpile Mine	Previous sample location. Collected to establish background concentration on Rio Moquino.
RM-JM-SW-(date) RM-JM-SED-(date)	Surface water Sediment	Rio Moquino within the mine boundaries, upstream of its confluence with Rio Paguate	Previous sample location. This sample location established an observed release during 2010 SI sampling. Collected to establish migration of contaminants from mine to surface water
RP-JM-SW-(date) RP-JM-SED-(date)	Surface water Sediment	Rio Paguate within the mine boundaries, upstream of its confluence with Rio Moquino	Previous sample location. This sample location established an observed release during 2010 SI sampling. Collected to establish migration of contaminants from mine to surface water
RP-JM-SW-01-(date) RP-JM-SED-01	Surface water Sediment	Rio Paguate after the confluence of it with Rio Moquino and within mine boundaries.	Previous sample location. This sample location established an observed release during 2010 SI sampling. Collected to establish migration of contaminants from mine to surface water
RP-SW-01-(date) RP-SED-01-(date)	Surface water Sediment	Rio Paguate on the southern end of the mine boundary	Previous sample location. This sample location established an observed release during 2010 SI sampling. Collected to establish migration of contaminants from mine to surface water
RP-SW-01-(date) RP-SED-01-(date)	Surface water Sediment	Rio Paguate on the southern end of the mine boundary	Previous sample location. This sample location established an observed release during 2010 SI sampling. Collected to establish migration of contaminants from mine to surface water
RP-SW-02-(date) RP-SED-02-(date)	Surface water Sediment	Rio Paguate downstream of Jackpile Mine.	Previous sample location. This sample location established an observed release during 2010 SI sampling. Collected to establish migration of contaminants from mine to surface water
RP-SW-02-(date) RP-SED-02-(date)	Surface water Sediment	Rio Paguate downstream of Jackpile Mine.	Previous sample location. This sample location established an observed release during 2010 SI sampling. Collected to establish migration of contaminants from mine to surface water
PR-SW-01-(date) PR-SED-01-(date)	Surface water Sediment	Paguate Reservoir (aka Mesita Reservoir) downstream of Jackpile Mine.	Previous sample location. This sample location established an observed release during 2010 SI sampling. Collected to establish migration of contaminants from mine to surface water
MR-SW-(date)	Surface water	Irrigation canal off the Mesita Reservoir (aka Paguate Reservoir) downstream of Jackpile Mine. (not on figure – to be determined in field)	This sample location is being collected per request from the Village of Mesita
MW-RM-(date)	Groundwater	Monitoring well located off Rio Moquino, upgradient of Jackpile Mine.	Collected to establish background concentration upgradient and north of Jackpile Mine.
MW-1-(date)	Groundwater	Monitoring well located upgradient and to the northwest of Jackpile Mine.	Collected to establish background concentration upgradient of Jackpile Mine.
MW-8-(date)	Groundwater	Monitoring well located upgradient and to the west of Jackpile Mine.	Collected to establish background concentration upgradient of Jackpile Mine.

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Sample Name	Sample Matrix	Sample Location (refer to Figure 3-1)	Rationale
MW-7-(date)	Groundwater	Monitoring well located upgradient and to the west of Jackpile Mine.	Collected to establish background concentration upgradient of Jackpile Mine.
SPOP35-(date)	Groundwater	Monitoring well located within South Paguate Pit	Collected to determine whether CoCs identified during the 2010 SI sampling event are significantly elevated in groundwater with respect to background concentrations
Well#4-(date)	Groundwater	Monitoring well located within Jackpile Mine along Rio Paguate	Collected to determine whether CoCs identified during the 2010 SI sampling event are significantly elevated in groundwater with respect to background concentrations
MW-3-(date)	Groundwater	Monitoring well located within Jackpile Mine along Rio Paguate	Collected to determine whether CoCs identified during the 2010 SI sampling event are significantly elevated in groundwater with respect to background concentrations
NPOP20E-(date)	Groundwater	Monitoring well located within North Paguate Pit	Collected to determine whether CoCs identified during the 2010 SI sampling event are significantly elevated in groundwater with respect to background concentrations
JPOP41N-(date)	Groundwater	Monitoring well located within Jackpile Pit	Collected to determine whether CoCs identified during the 2010 SI sampling event are significantly elevated in groundwater with respect to background concentrations
MW-2-(date)	Groundwater	Monitoring well located just south and downgradient of mine	Collected to determine whether CoCs identified during the 2010 SI sampling event are significantly elevated in groundwater with respect to background concentrations
MW-6-(date)	Groundwater	Monitoring well located south and downgradient of mine	Collected to determine whether CoCs identified during the 2010 SI sampling event are significantly elevated in groundwater with respect to background concentrations
MW-MD-(date)	Groundwater	Monitoring well located downgradient of mine and west of Mesita Dam	Collected to determine whether CoCs identified during the 2010 SI sampling event are significantly elevated in groundwater with respect to background concentrations

4. ANALYTICAL METHODS

START-3 will collect samples for both radiological and chemical analysis. Tables 4-1 and 4-2 summarize the samples that will be collected, including the volumes, container types, and associated analytical methods.

4.1 RADIOLOGICAL ANALYSIS

Samples collected by START-3 during the ESI will be analyzed by a NELAP certified laboratory. Surface water, sediment, and groundwater samples will be submitted for the following analyses:

- Isotopic Uranium (including isotopes 234, 235, and 238) by ASTM 3972-90M alpha spectrometry (groundwater only).
- Gross alpha, beta, and gamma radiation by EPA Method 9310.
- Radium 226 + 228 by EPA Method 903.1.

4.2 CHEMICAL ANALYSIS

Samples collected by START-3 during the ESI will be analyzed by NELAP certified laboratory. Surface water, sediment, and groundwater samples will be submitted for the following analyses:

- Total Metals by SW-846 Method 6010B
- Mercury by SW-846 Method 7470/7471.

In addition, surface water and groundwater will be submitted for the following analyses:

- Total Dissolved Solids (TDS) by EPA Method 160.1
- General Anion Chemistry by EPA Method 9056.

Table 4-1
Requirements for Containers, Preservation Techniques,
Sample Volumes, and Holding Times
Jackpile-Paguate Uranium Mine
Paguate, Cibola County, New Mexico

Name	Analytical Methods	Container	Preservation	Minimum Sample Volume or Weight	Maximum Holding Time
TAL Metals and Mercury	SW846 6010B and SW846 7470/7471	Polyethylene (water), Glass (solid)	HNO ₃ to pH<2 (water), 4°C	500 mL, 8oz	28 days for mercury 180 days all other metals
General Chemistry (anions)	SW846 9056	Polyethylene (water)	NA	500 mL,	28 days
Total Dissolved Solids	SW846 160.1	Polyethylene (water)	NA	500 mL	7 days
Uranium (isotopic)	Alpha Spec ASTM 3972-90M	Polyethylene (water), Glass (solid)	HNO ₃ to pH< 2 (water), NA (soil)	1 liter, 8 oz	6 months
Gross alpha, beta, gamma	SW-846 9310	Polyethylene (water), Glass (solid)	HNO ₃ to pH< 2 (water), NA (soil)	1 liter, 8 oz	NA
Radium 226+228	SW-846 903/9315	Polyethylene (water), Glass (solid)	HNO ₃ to pH< 2 (water), NA (soil)	1 liter, 8 oz	NA

Table 4-2
Field and Laboratory QA/QC and Analysis Summary
Jackpile-Paguate Uranium Mine
Paguate, Cibola County, New Mexico

Sample Type	Sample Collection Method	No. of Samples	Rationale	EPA Analytical Method
Groundwater	SOP 1002.2	8	Extent of contamination	SW846 6010B SW846 7470/7471 SW846 7199 ASTM 3972-90M SW846 9310 SW846 903 SW-846 160.1
Groundwater	SOP 1002.2	4	Background	SW846 6010B SW846 7470/7471 SW846 7199 ASTM 3972-90M SW846 9310 SW846 903 SW-846 160.1
Duplicate Groundwater (10%)	SOP 1002.2	2	QA/QC	SW846 6010B SW846 7470/7471 SW846 7199 ASTM 3972-90M SW846 9310 SW846 903 SW-846 160.1
Surface Water (water)	SOP 1002.1	7	Extent of contamination	SW846 6010B SW846 7470/7471 SW846 7199 SW846 9310 SW846 903 SW-846 160.1
Surface Water (water)	SOP 1002.1	1	Village of Mesita request	SW846 6010B SW846 7470/7471 SW846 7199 SW846 9310 SW846 903 SW-846 160.1
Surface Water (water)	SOP 1002.1	2	Background	SW846 6010B SW846 7470/7471 SW846 7199 SW846 9310 SW846 903 SW-846 160.1
Duplicate Surface Water (10%)	SOP 1002.1	1	QA/QC	SW846 6010B SW846 7470/7471 SW846 7199 SW846 9310 SW846 903 SW-846 160.1
Surface Water (sediment)	SOP 1002.4	7	Extent of contamination	SW846 6010B SW846 7470/7471 SW846 9310 SW846 903
Surface Water (sediment)	SOP 1002.4	2	Background	SW846 9310 SW846 903
Duplicate Sediment (10%)	SOP 1002.4	1	QA/QC	SW846 6010B SW846 7470/7471 SW846 9310 SW846 903
Rinsate Blanks ¹	N/A	5	QA/QC	SW846 6010B SW846 7470/7471 SW846 9310 SW846 903

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TDD TO-0019-10-11-01

Table 4-2 (Continued)
Field and Laboratory QA/QC and Analysis Summary
Jackpile-Paguate Uranium Mine
Paguate, Cibola County, New Mexico

Sample Type	Sample Collection Method	No. of Samples	Rationale	EPA Analytical Method
Temperature Blanks ²	N/A	5	QA/QC	Vial temperature measured upon arrival at laboratory

Note:

¹Rinsate blanks: samples will be collected at the rate of 1 per day per nondisposable sampling equipment.

²Temperature blanks: samples will be collected at a rate of 1 per cooler.

5. DATA VALIDATION

START-3 will validate the radioanalytical data by having each data set reviewed by a professional health physicist. A summary of the data validation and findings will be presented in Summary Reports as part of the final report. START-3 will evaluate the following to verify that the radioanalytical data are within acceptable QA/QC tolerances:

- The completeness of the Laboratory Reports, verifying that all required components of the report are present and that the samples indicated on the accompanying chain-of-custody are addressed in the report.
- The results of laboratory blank analyses.
- The results of laboratory control sample (LCS) analyses.
- Compound identification and quantification accuracy relative to expected isotopic ratios for uranium and its decay products.
- Laboratory precision, through review of the results for blind field duplicates.

The inorganic analytical data generated by the designated laboratory will be validated using EPA-approved data validation procedures in accordance with the EPA *CLP National Functional Guidelines* for Inorganic Data Review (October 2004). A summary of the data validation findings will be presented in Data Validation Summary Reports as part of the final report. The following will be evaluated to verify that the analytical data is within acceptable QA/QC tolerances:

- The completeness of the Laboratory Reports, verifying that all required components of the report are present and that the samples indicated on the accompanying chain-of-custody are addressed in the report.
- The calibration and tuning records for the laboratory instruments used for the sample analyses.
- The results of internal standards analyses.
- The results of laboratory blank analyses.
- The results of LCS analyses.
- The results of MS/MSD analyses.
- Compound identification and quantification accuracy.
- Laboratory precision, by reviewing the results for blind field duplicates.

Variances from the QA/QC objectives will be addressed as part of the Data Validation Summary Reports.

6. QUALITY ASSURANCE

Quality assurance will be conducted in accordance with the WESTON Corporate Quality Management Manual, dated March 2004; the WESTON START-3 Quality Management Plan, dated August 2007; and EPA Quality Assurance/Quality Control Guidance for Removal Activities, dated April 1990. Following receipt of the TDD from EPA, a Quality Control (QC) officer is assigned and monitors work conducted throughout the entire project including reviewing interim report deliverables and field audits. The START-3 PTL will be responsible for QA/QC of the field investigation activities. The designated laboratory utilized during the investigation will be responsible for QA/QC related to the analytical work. START-3 will also collect samples to verify that laboratory QA/QC is consistent with the required standards and to validate the laboratory data received.

6.1 SAMPLE CUSTODY PROCEDURES

Because of the evidentiary nature of sample collection, the possession of samples must be traceable from the time the samples are collected until they are introduced as evidence in legal proceedings. After sample collection and identification, samples will be maintained under chain-of-custody (COC) procedures. If the sample collected is to be split (laboratory QC), the sample will be allocated into similar sample containers. Sample labels completed with the same information as that on the original sample container will be attached to each of the split samples. All personnel required to package and ship coolers containing potentially hazardous material will be trained accordingly.

START-3 personnel will prepare and complete chain-of-custody forms using the Scribe Environmental Sampling Data Management System (SCRIBE) for all samples sent to a START-3 designated off-site laboratory. The chain-of-custody procedures are documented and will be made available to all personnel involved with the sampling. A typical chain-of-custody record will be completed each time a sample or group of samples is prepared for shipment to the laboratory. The record will repeat the information on each sample label and will serve as documentation of handling during shipment. A copy of this record will remain with the shipped samples at all times, and another copy will be retained by the member of the sampling team who

originally relinquished the samples. At the completion of the project, the data manager will export the SCRIBE chain-of-custody documentation to the Analytical Service Tracking System (ANSETS) database.

Samples relinquished to the participating laboratories will be subject to the following procedures for transfer of custody and shipment:

- Samples will be accompanied by the COC record. When transferring possession of samples, the individuals relinquishing and receiving the samples will sign, date, and note the time of the sample transfer on the record. This custody records document transfer of sample custody from the sampler to another person or to the laboratory.
- Samples will be properly packed for shipment and dispatched to the appropriate laboratory for analysis with separate, signed custody records enclosed in each sample box or cooler. Sample shipping containers will be custody-sealed for shipment to the laboratory. The preferred procedure includes use of a custody seal wrapped across filament tape that is wrapped around the package at least twice. The custody seal will then be folded over and stuck to seal to ensure that the only access to the package is by cutting the filament tape or breaking the seal to unwrap the tape.
- If sent by common carrier, a bill of lading or airbill will be used. Bill of lading and airbill receipts will be retained in the project file as part of the permanent documentation of sample shipping and transfer.

SOPs 1101.01 and 1102.01 describe these procedures in more detail.

6.2 PROJECT DOCUMENTATION

All documents will be completed legibly in ink and by entry into field logbooks and SCRIBE. Response Manager will be used after direction of the EPA SAM.

6.2.1 Field Documentation

The following field documentation will be maintained as described below.

Field Logbook

The field logbook is a descriptive notebook detailing site activities and observations so that an accurate, factual account of field procedures may be reconstructed. All entries will be signed by the individuals making them. Entries should include, at a minimum, the following:

- Site name and project number.
- Names of personnel on-site.
- Dates and times of all entries.
- Description of all site activities, including site entry and exit times.
- Noteworthy events and discussions.
- Weather conditions.
- Site observations.
- Identification and description of samples and locations.
- Subcontractor information and names of on-site personnel.
- Dates and times of sample collections and chain-of-custody information.
- Records of photographs.
- Site sketches.
- Calibration results.

Sample Labels

Sample labels will be securely affixed to the sample container. The labels will clearly identify the particular sample and include the following information:

- Site name and project number.
- Date and time the sample was collected.
- Sample preservation method.
- Analysis requested.
- Sampling location.

Chain-of-Custody Record

A chain-of-custody will be maintained from the time of sample collection until final deposition. Every transfer of custody will be noted and signed for, and a copy of the record will be kept by each individual who has signed it.

Custody Seal

Custody seals demonstrate that a sample container has not been tampered with or opened. The individual who has custody of the samples will sign and date the seal and affix it to the container in such a manner that it cannot be opened without breaking the seal.

Photographic Documentation

START-3 will take photographs to document site conditions and activities as site work progresses. Initial conditions should be well documented by photographing features that define

the site-related contamination or special working conditions. Representative photographs should be taken of each type of site activity. The photographs should show typical operations and operating conditions as well as special situations and conditions that may arise during site activities. Site final conditions should also be documented as a record of how the site appeared at completion of the work.

All photographs should be taken with either a film camera or digital camera capable of recording the date on the image. Each photograph will be recorded in the logbook with the location of the photographer, direction the photograph was taken, the subject of the photograph, and its significance (i.e., why the picture was taken).

6.2.2 Report Preparation

At the completion of the project, START-3 will review and validate all laboratory data and prepare a draft report of field activities and analytical results for EPA SAM review. Draft deliverable documents will be uploaded to the EPA TeamLink website for EPA SAM review and comment.

APPENDIX A

EPA CONTRACT LABORATORY PROGRAM GUIDANCE FOR FIELD SAMPLERS



OSWER 9240.0-44
EPA 540-R-07-06

FINAL July 2007

Office of Superfund Remediation and Technology Innovation



Sampler's Guide



Contract Laboratory Program Guidance for Field Samplers

Disclaimer: The final version of the document replaces any prior versions of the document in their entirety.

Foreword

The intent of the Contract Laboratory Program (CLP) Guidance for Field Samplers is to replace the CLP Samplers Guide. This guidance document is designed to provide users with general information regarding environmental sample collection for the United States Environmental Protection Agency's (USEPA) Contract Laboratory Program (CLP). This document provides minimum CLP requirements, an explanation of the general sampling process sequence of events, and any related information. The appendices contain useful reference information and checklists to aid in planning and documenting sampling activities.

CLP users also are encouraged to review the Introduction to the Contract Laboratory Program document that contains a general overview of the CLP, how it works, and how to access the program. The CLP requires samplers to use the functionality provided by the Field Operations Records Management System (FORMS) II Lite™ software, which is the preferred means of creating CLP sample documentation. For guidance in using the software to record and submit sampling data, users should reference the FORMS II Lite User's Guide.

Both the Introduction to the Contract Laboratory Program and the Contract Laboratory Program Guidance for Field Samplers can be downloaded from the CLP Web site at the following address:

<http://www.epa.gov/superfund/programs/clp/guidance.htm>

The FORMS II Lite User's Guide can be downloaded from the CLP Web site at the following address:

<http://dyncsdao1.fedcsc.com/itg/forms2lite/doc.html>

For more information regarding the CLP or this guide, please contact Elizabeth Holman via email at Holman.Elizabeth@epa.gov or via telephone at (703) 603-8761.

Key Information

Text in [blue](#) and underlined indicates an external link to information outside of this document.

The images below are located throughout the document to draw attention to important information and each are labeled accordingly:



Important



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List of Acronyms

ASB	Analytical Services Branch
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
CLP PO	CLP Project Officer
CRQL	Contract Required Quantitation Limit
CVAA	Cold Vapor Atomic Absorption
DOT	Department of Transportation
DQO	Data Quality Objective
dbf	Database File
ET	Eastern Time
FORMS II Lite™	Field Operations Records Management System II Lite
FSP	Field Sampling Plan
HCN	Hydrocyanic acid
IATA	International Air Transport Association
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NAHSO₄	Sodium Bisulfate
NPL	National Priorities List
OSC	On-scene/on-site Coordinator
OSHA	Occupational Safety and Health Administration
OSRTI	Office of Superfund Remediation and Technology Innovation
OSWER	Office of Solid Waste and Emergency Response
PCBs	Polychlorinated Biphenyls
PE	Performance Evaluation
PM	Program Manager
ppb	Parts-Per-Billion
ppt	Parts-Per-Trillion
PRP	Potentially Responsible Party
PT	Proficiency Testing
PTFE	Polytetrafluoroethylene
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QASPER	Quality Assurance Sampling Plan for Environmental Response
QATS	Quality Assurance Technical Support
QC	Quality Control
RAS	Routine Analytical Services
RPM	Remedial Project Manager
RSCC	Regional Sample Control Center Coordinator
RSM	Regional Site Manager
SAM	Site Assessment Manager
SAP	Sampling Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SDG	Sample Delivery Group
SMC	System Monitoring Compound
SMO	Sample Management Office
SOP	Standard Operating Procedure
SOW	Statement of Work
SVOA	Semivolatile Organic Analyte
TR/COC	Traffic Report/Chain of Custody
txt	Text File
UN	United Nations
USEPA	United States Environmental Protection Agency
VOA	Volatile Organic Analyte
XML	eXtensible Markup Language

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1.0 INTRODUCTION

1.1 About this Guide

This document describes the important organizational roles and responsibilities for those who plan and conduct environmental sample collection projects for analysis through the Superfund's Contract Laboratory Program (CLP). This chapter introduces the structure and purpose of this document. Chapter 2, *Pre-field Activities*, addresses pre-field planning activities that the sampling team could complete prior to the actual sampling event. Chapter 3, *In-field Activities*, addresses those activities that need to be completed during the sampling event.

Appendix A describes the functions within a sampling project which are taken from the Quality Assurance Project Plan requirements. Appendix B and Appendix C contain the sample collection guidelines for Volatile Organic Analytes (VOAs) in soil and in water. Appendix D recommends sampling techniques. Appendix E contains checklists to help the sampler ensure that all necessary steps are completed.



A project and site-specific Quality Assurance Project Plan (QAPP) providing Regional guidance will override guidance given within this document.

1.2 Overview of the CLP

The CLP is a national program of commercial laboratories under contract to support the USEPA's nationwide effort to clean up designated hazardous waste sites by supporting its Superfund program. The Superfund program was originally established under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and presently exists under the Superfund Amendments and Reauthorization Act (SARA) of 1986.

The CLP uses state-of-the-art technology to provide users with analytical services. The program provides data of known and documented quality to support USEPA enforcement activities or other user needs. To achieve this goal, the CLP has established strict Quality Control (QC) procedures and detailed documentation requirements. Current CLP users include the USEPA Regions, States and Tribal governments, and other Federal agencies. CLP users also are encouraged to review the *Introduction to the Contract Laboratory Program* document that contains a general overview of the CLP, how it works, and how to access the program.

1.2.1 Key Players Within the CLP

In coordinating Superfund sampling efforts, the Analytical Services Branch (ASB) is supported by the Sample Management Office (SMO) contractor, the Regional CLP Project Officers (CLP POs), the Regional Sample Control Center Coordinators (RSCCs), and the Regional Site Managers (RSMs), including Site Assessment Managers (SAMs), On-scene/On-site Coordinators (OSCs), and Remedial Project Managers (RPMs). Samplers may work directly with the RSCC and/or RSM (or equivalent), and/or an OSC from the Field Support Section during a sampling event. See Table 1-1 for a brief description of the functions performed by key participants (functions may vary by Region).

Table 1-1. Participants in the CLP Sampling Process

Participants	Responsibilities
Analytical Services Branch	<p>USEPA ASB directs the CLP from within the Office of Superfund Remediation and Technology Innovation (OSRTI) in the Office of Solid Waste and Emergency Response (OSWER). ASB responsibilities include:</p> <ul style="list-style-type: none"> • Development of the Statements of Work (SOWs) that define required analytical methods (including QC, detection/quantitation limits, and holding times) for the analytical services procured under the CLP; • Development and implementation of policies and budgets for Superfund analytical operations; • Development of information management policies and products for analytical data; • Management of SMO and Quality Assurance Technical Support (QATS) contracts; • National administration, evaluation, and management of the CLP; and • Direction of CLP Quality Assurance (QA) activities in coordination with overall OSWER QA activities. <p>To obtain the most current ASB contact list, refer to the following Web site: http://www.epa.gov/superfund/programs/clp/contacts.htm#ASB</p>
CLP Sample Management Office	The contractor-operated SMO provides necessary management, operations, and administrative support to the CLP. SMO receives Regional analytical requests, coordinates and schedules sample analyses, and tracks sample shipments. SMO also receives and checks data for completeness and compliance, processes laboratory invoices, and maintains a repository of sampling records and program data.
CLP Contract Laboratories	The contractor-operated laboratories within CLP provide necessary analytical services for the isolation, detection, and quantitation of the CLP's target compounds and analytes.
Regional CLP Project Officer	<p>The CLP PO monitors the technical performance of the contract laboratories in each Region. The CLP PO works closely with ASB Program Managers (PMs) to identify and resolve laboratory technical issues, and leads laboratory on-site evaluations. To obtain the most current CLP PO contact list, refer to the following Web site:</p> <p>http://www.epa.gov/superfund/programs/clp/polist.htm</p>
Regional Sample Control Center Coordinator	<p>In most Regions, the RSCC coordinates sampling efforts and serves as the central point-of-contact for sampling questions and problems. The RSCC works with SMO to schedule sample shipments to laboratories. In addition, the RSCC's activities may include: informing SMO of sample shipment, cancellations, special instructions, and sampling issues. To obtain the most current RSCC contact list, refer to the following Web site:</p> <p>http://www.epa.gov/superfund/programs/clp/rscclist.htm</p>
Regional Site Manager	The RSM Coordinates the development of acceptance or performance criteria and oversees project-specific contractors, state officials, or private parties conducting site sampling efforts. The RSM could be the SAM, the OSC, or the Remedial Project Manager (RPM).
Field Support Section	The Field Support Section consists of personnel such as the OSC, SAM, and RPM. In most Regions, the Field Support Section develops Standard Operating Procedures (SOPs) for field sampling and related procedures, and assists sampling teams in following those SOPs. The sampling team determines what type(s) of CLP services will be required for a particular sampling event. The Field Support Section reviews Sampling Analysis Plans (SAPs) prepared by sampling teams and oversees sampling teams in the field. The Field Support Section may also prepare their own SAPs, perform sampling activities in the field, and analyze and report the results of their sampling events to the RSM.

1.3 Overview of the Sampling Process

Once USEPA has determined that physical, chemical, and/or biological testing of a site is necessary, samples of material from the site area must be collected. The type of material that must be collected and the analytical method to be used depends upon the physical location of the site, detection level(s), site history (previous sampling), and known or unknown conditions and contaminants. The sampling process includes carefully planned and consistently applied procedures that produce accurate and legally defensible data. The sampling team should consider the procedures and plans presented in this guide as minimum sampling process guidelines to maintain sample integrity and identity. Samples should be collected according to the approved project and site-specific QAPP and SAP. This document does not define specific sampling procedures because specific sampling protocols depend on individual site conditions, Regional requirements, and acceptance and performance criteria. Since Regions may have their own specific requirements for individual sampling programs, they are responsible for generating Region-specific sampling SOPs.

At-a-Glance: Overview of the Sampling Process

- ✓ Procedures must be consistent.
- ✓ Analytical data must be accurate and defensible.
- ✓ Procedures must meet minimum requirements.

1.3.1 Procedures Must be Consistent

The purpose of sampling is to collect representative portions from a suspected contaminated site. Sample collection is critical to determining the presence, type, concentration, and extent of environmental contamination by hazardous substances, thus it is a crucial part of every sampling and environmental testing effort. Sampling procedures must be consistently written and followed to mitigate risk of error and the expense of re-sampling.

Failure to follow proper sampling and shipping procedures could result in samples that are contaminated, broken, mislabeled, lost during shipping, or unusable because of a missed holding time. If procedures are inconsistently or improperly followed, any resultant analytical data may be inaccurate and may not be defensible in a court of law.



If re-sampling is needed due to improper sampling, the sampling team may incur the cost.

1.3.2 Analytical Data Must be Accurate and Defensible

The data gathered during sampling activities helps to accurately characterize contaminated waste sites so that the impact on human health and the environment can be properly evaluated. Acquiring accurate and defensible data that will be accepted in a court of law is the CLP's primary objective; therefore, the sampler must collect samples according to strict sampling procedures, plans, and guidelines. USEPA and many other Federal agencies use data resulting from analytical testing of soil/sediment/aqueous samples to:

- Determine if a site is contaminated with organic and/or inorganic compounds;
- Identify pollution sources and Potentially Responsible Parties (PRPs);
- Validate remedial design methodologies;
- Assess response and remedial priorities;
- Assess risk to human health and the environment;
- Determine appropriate cleanup actions; and
- Determine cleanup achievements.

1.3.3 Sampling Procedures and Guidelines Must Meet Minimum Requirements

It is imperative that samplers be aware of the minimum CLP and Regional requirements that directly impact and define how a sampling event will take place. It is important to note that the procedures and guidelines set forth in this document are considered minimum CLP requirements. Samplers should reference the following sections within this document that specifically address important requirements that must be met for a successful sampling event:

- Section 1.4.1 CLP Documentation Requirements;
- Section 2.4.1 Request Scheduling of Analysis, SMO-assigned Case Numbers, CLP Sample Numbers, and Laboratory Contact Information;
- Section 2.7 Comply with Transportation and Shipping Requirements;
- Section 2.8 Provide Shipment Notification;
- Section 3.1 Collect Samples; and
- Section 3.2 Complete Documentation.

1.4 Overview of Sampling Documentation Requirements

The sampler must properly document samples collected for analysis in order to uniquely identify each sample and ensure adequate chain-of-custody procedures. When collecting samples, the sampler should always keep in mind that any samples collected may be used in future litigation. This is especially important when samples are from privately owned property. If sampling on privately owned property, samplers should also provide the property owner with a receipt for samples collected and removed from that owner's property. Samplers may also be required by a Region to use a sample label, sample tag, or field operations records documenting information such as daily activities, equipment and materials used, personnel involved, site security, etc. These types of documentation help ensure proper sample identification and provide additional chain-of-custody records.

The documentation required by a Region for a sampling event is outlined in project plans such as the QAPP, SAP, and Field Sampling Plan (FSP).

At-a-Glance: Overview of the Sampling Document Requirements

- ✓ Must use FORMS II Lite to create sample documentation. Analytical data must be accurate and defensible.
- ✓ CLP documentation requirements:
 - CLP Sample Number
 - SMO-assigned Case Number
 - Traffic Report/Chain of Custody (TR/COC) Record
 - Sample Labels
 - Sample Tags
 - Custody Seals
 - Field Operation Records



Under no circumstances should the site name appear on any documentation that is sent to the laboratory (for the CLP).

1.4.1 CLP Documentation Requirements

Samplers must:

- 1) Record the CLP Sample Number on each sample bottle;
- 2) Complete the Traffic Report/Chain of Custody (TR/COC) Record using the FORMS II Lite software, making sure to indicate on the TR/COC Record if the samples require the use of a Modified Analysis;
- 3) Complete and attach sample labels;
- 4) Complete and attach sample tags to meet Regional requirements;
- 5) Complete and attach custody seals to meet Regional requirements; and
- 6) Complete field operations records, as necessary.

Please contact your RSCC (see Table 1-1) for information regarding CLP Sample Numbers, SMO-assigned Case Numbers, TR/COC Records, and chain-of-custody seals for sampling events.

For information regarding using FORMS II Lite to create and complete a TR/COC Record, refer to the following Web site:

<http://www.epa.gov/superfund/programs/clp/f2lite.htm>

1.4.1.1 CLP Sample Number

A CLP Sample Number is unique per sampling location and is used to identify and track samples throughout the sampling and analytical processes and is recorded on many types of sampling documentation (e.g., TR/COC Records, sample labels, and sample tags). CLP Sample Numbers are provided to samplers by their RSCC or SMO.

Samplers must contact their RSCC (or their designee) to obtain CLP Sample Numbers for their sampling event. Samplers must correctly assign the CLP Sample Numbers to the appropriate sample bottle or container. Please refer to Section 3.2.1 for more detailed information regarding the use of CLP Sample Numbers.



If the sampler has any questions regarding the assignment of CLP Sample Numbers, they should contact their RSCC.

1.4.1.2 SMO-assigned Case Number

SMO-assigned Case Numbers are used to track groups of samples throughout the sampling and analytical processes and are recorded on many types of sampling documentation (e.g., TR/COC Records, sample labels, and sample tags). Samplers must correctly assign the SMO-assigned Case Number to the appropriate sample bottle or container. To obtain a SMO-assigned Case Number, samplers must contact their RSCC (or their designee).

1.4.1.3 Laboratory Assignment

Samplers are responsible for shipping samples to the appropriate SMO-assigned laboratory for analysis. Samplers must contact their RSCC (or their designee) to obtain their laboratory assignment or they may be provided by SMO.

1.4.1.4 TR/COC Record

The TR/COC Record is used as physical evidence of sample custody and functions as a permanent record of each sample collected.

Per CLP documentation requirements, each cooler must contain a TR/COC Record that lists all the samples contained therein.

In an effort to automate sample documentation in the field, ASB has developed a stand-alone, Windows-based software application that samplers can use to automatically create and generate sample documentation. The FORMS II Lite software allows users to enter information prior to and during sampling events. It allows users to multi-task and electronically create, edit, and print documentation associated with sampling activities. Users can customize data entry screens throughout the entire documentation process. Users can also customize the format and content of sample labels based on specific requirements.

The program simplifies and accelerates the tedious manual sample documentation process by reducing the generation of handwritten documents by almost 70%. The FORMS II Lite software enables samplers to:

- Increment CLP Sample Numbers or manually assign their own unique, project-specific non-CLP Sample Numbers;
- Input the SMO-assigned Case Number into the appropriate field;
- Create sample labels, sample tags, TR/COC Records, Sample Weight forms, and receipts for samples taken from a site;
- Track samples from the field to the laboratory;

- Electronically capture sample information into databases; and
- Export electronic data as a database File (.dbf), Text (.txt), or eXtensible Markup Language (.xml) file.

USEPA requires samplers to use the FORMS II Lite software for all CLP sampling efforts. For assistance with obtaining or using the FORMS II Lite software, please contact the FORMS II Lite Help Desk at 703-818-4200 from 9:00 AM - 5:00 PM Eastern Time (ET). For additional information regarding FORMS II Lite use and training, please refer to the following Web site:

<http://www.epa.gov/superfund/programs/clp/f2lite.htm>

1.4.1.5 Chain-of-Custody Seals

A chain-of-custody seal is any adhesive label or tape that can be used to seal a sample bottle, container, plastic bag, or shipping cooler such that if it is opened or tampered with, the seal will be broken. Custody seals must be placed on each sample bottle, container, or bag (as appropriate) and each shipping cooler or container. The custody seal is an excellent means of maintaining a record of chain-of-custody, as well as guarding against possible sample contamination or tampering during shipping.

1.4.1.6 Sample Labels

A sample label is a sticker attached to a sample bottle or container that contains a sample. Sample labels are affixed to each sample container as samples are collected in the field or affixed prior to going in the field. A sample label must contain, at a minimum, a CLP Sample Number so that they can be associated with, and listed on, the associated TR/COC Record. The sample label may also include the required analysis/fraction and preservative used (to eliminate confusion at the laboratory). Samplers should refer to their project plans for Region-specific sample label requirements.

1.4.1.7 Sample Tags

A sample tag identifies a sample bottle or container that contains a sample. The tag also provides specific analytical direction and proof that a sample existed. To support the use of sample data in potential enforcement actions, samples with other than in situ measurements (e.g., pH, temperature, conductivity) can be identified with a sample tag. A CLP Sample Number and SMO-assigned Case Number must be recorded on a sample tag to indicate that the sample container comprises the whole sample in the case where there is just one container of sample, or part of the indicated sample in the case of multiple containers of sample. Samplers should refer to their project plans for Region-specific sample tag requirements.

1.4.1.8 Field Operation Records

Samplers should maintain complete, accurate, and legible field operations records as they perform a sampling activity. The following records are included: Field Logbooks; Corrective Action Reports; Sampling Trip Reports; supplemental standardized forms; logs; and records such as maps or photographs that document each step of the work performed in the field. Samplers should refer to their project plans for Region-specific field operations record requirements. These records are very important tools because they are considered part of the official project file when legal issues arise.

1.4.1.9 Weight Logs

A sample weight log identifies the tared, sample and final weights per bottle for VOA samples. In order to support Method 5035 for VOAs, samplers should enter tared and final weights per bottle in the CLP Sample Weight Log.

2.0 PRE-FIELD ACTIVITIES

This chapter provides instructions for completing the suggested pre-field activities that samplers could complete prior to performing sampling activities. These important pre-field activities will save time and help the sampler to better prepare for the sampling event. Samplers should be aware of issues routinely arise during the sampling process so that samplers can avoid making the same mistakes or having the same problems that could adversely affect their sampling event. Samplers are also expected to review all pertinent project plans and meet both CLP and Regional requirements that directly impact the structure and purpose of a sampling event.

The project plans provide information such as the types and numbers of samples to be collected, the analytical methods to be used based on the desired level of quantitation, and the necessary equipment and supplies. The plans also describe the sampling method which may require different specific sample volumes/masses, containers, preservation, shipping, and handling to maintain the integrity of the samples without degradation or contamination.

In addition to reviewing project plans, samplers should determine if the sampling site is privately or publicly owned and obtain the necessary permission to access the sampling site. If the site is privately owned, samplers should make sure to have receipts for available samples to provide to the owner for all samples collected and removed from their property. Samplers must also prepare to identify and obtain sampling materials, prepare to meet documentation requirements by obtaining and learning to use the required software, comply with transportation and shipping requirements, and perform a readiness review/dry run of the sampling process.

At-a-Glance: Pre-field Activities

- ✓ Prepare for and communicate during a sampling event.
- ✓ Review project plans containing Regional requirements.
- ✓ Plan to meet documentation requirements.
- ✓ Obtain any necessary permits, licenses, and clearances.
- ✓ Identify and obtain sampling materials.
- ✓ Comply with transportation and shipping requirements.
- ✓ Provide shipment notification.
- ✓ Perform Readiness Review/Run-through.

2.1 Prepare for a Sampling Event

Samplers must prepare to meet CLP and Regional requirements for a sampling event, appropriately use the CLP Sample Number and SMO-assigned Case Number, complete the TR/COC Record using the FORMS II Lite software, and complete and attach the custody seal(s). It is very important that the sampler include the correct CLP Sample Number on each sample. It is also imperative that the TR/COC Record be accurately completed and submitted with the sample(s). Finally, the sampler must accurately and legibly complete and attach a custody seal to each sample container, or plastic sample bag (as appropriate), and each shipping cooler or container.

However, meeting the sampling requirements requires more than just the proper application of a CLP Sample Number on each sample, completion of the TR/COC Record, and use of a custody seal. The actual collection of samples, packaging, and shipping of those samples are equally important to a successful sampling event.

For example, if a sampler collects an insufficient volume of a sample, the laboratory may not be able to perform the requested analysis. Insufficient sample volumes may also result in a laboratory being unable to perform laboratory quality control, such as Matrix Spike (MS), Matrix Spike Duplicate (MSD), and Duplicate sample analysis. Additionally, if the laboratory receives a sample that is either unpreserved or the sample pH is outside of the required range, the sample cannot be properly analyzed.

Unfortunately, improper shipping and labeling processes and procedures often result in:

- Samples being shipped to the wrong laboratory;
- Broken or empty samples being received at the laboratory; and
- Custody seals or sealant tape that is missing or broken on sample bottles, containers, plastic bags, or shipping coolers shipped to the laboratories.

The importance of completing the paperwork associated with a sampling event cannot be overemphasized. Samplers must make a conscientious effort to accurately complete the TR/COC Record since this is the main document used to derive vital information about a particular sample. The person completing a TR/COC Record

must be careful to avoid errors such as the appropriate sample(s) not being listed, or the wrong samples being listed. In an effort to eliminate such errors and the confusion that can be associated with handwritten TR/COC Records, samplers must use the FORMS II Lite software to complete the TR/COC Record and other associated sampling documentation.

It is extremely important that QC samples, including field sample duplicates, field samples for Matrix Spike and Matrix Spike Duplicate analyses, and Proficiency Testing (PT) samples, also known as Performance Evaluation (PE) samples, be designated and labeled per Regional guidance by samplers in the field. Mislabeling of QC samples can result in improper and/or inaccurate analysis of a sample at the laboratory.

2.2 Communicate During a Sampling Event

Communication is a key element in planning, administering, and conducting a sampling event. It is extremely important that all parties involved in a sampling event be in contact throughout the sampling process. The procedures and recommendations outlined in this guide are based on more than 20 years of experience. It has been demonstrated that approximately 50% of all sampling efforts have been negatively affected by incorrect sampling procedures and poor communication among participants.

The key elements of communication for a sampling event include the relationship between the RSCC, SMO, the samplers in the field, and the laboratories who will be accepting the samples. For instance, the samplers must contact the RSCC to start the process for setting up a sampling event. The RSCC will in turn contact SMO who will schedule the sampling event, establish laboratory availability, and arrange for the laboratory to accept projected samples. SMO will then communicate the laboratory assignment to the Region and possibly the sampler.



The sampler should contact the RSCC (per Regional guidelines) and allow enough time for the RSCC to contact SMO at least a week prior to the sampling event.

SMO provides SMO-assigned Case and CLP Sample Numbers in time for the sampling event. SMO also schedules a laboratory and makes sure the laboratory will not have any capacity problems. Communication is also important because if there is a change in the sampling event due to a cancellation or an increase or decrease in the number of samples that will be sent to the laboratory, the sampler can contact the RSCC who can work with SMO to remedy potential capacity, availability, or overbooking problems.

2.3 Review Project Plans Containing Regional Requirements

In addition to meeting CLP requirements, the sample collection process must fulfill numerous Regional requirements. These requirements are determined by a variety of factors that affect how samples should be collected for an individual sampling event. These factors include:

- The type of samples being collected (organic/inorganic, water, soil/sediment, etc.);
- The method by which the samples will be analyzed;
- The acceptance or performance criteria (i.e., Data Quality Objectives [DQOs]); and
- The type of data needed.

The QAPP for each sampling project is written to meet requirements outlined in the documents *EPA Requirements for Quality Assurance Project Plans* (QA/R-5), *EPA Guidance on Quality Assurance Project Plans* (G-5), and Regional QAPP preparation documents. The QAPP is prepared in advance of field activities and is used by samplers to develop any subsequent plans such as the Sampling SAP or the FSP. Samplers should review the QAPP and any subsequent project plans for information outlining the basic components of a sampling activity. QAPP and project plans should be finalized and approved by appropriate Regional QA personnel, the OSC, SAM, or the RPM before providing them to the sampling team. This should be done prior to the start of field activities. Appendix A explains the functions within a sampling project (as these functions relate to a sampling event) and the elements of that function as described in a typical QAPP. Copies of all project plans and relevant SOPs should be maintained in the field for the duration of the sampling project.

2.4 Plan to Meet Documentation Requirements

Sampling events require a variety of accurate and complete documentation. Samplers should review their project plans to determine the types of documentation that must be completed for a sampling project and to ensure that the appropriate documentation will be on-hand in the field. The CLP documentation requirements include the CLP Sample Number, the SMO-assigned Case Number, the TR/COC Record, sample labels, sample tags, custody seals, and field operations records (as necessary). Samplers need to request SMO-assigned Case and CLP Sample Numbers for each sampling event prior to starting field activities. Samplers also need to make sure that the correct TR/COC Records (Organic TR/COC Record for organic analysis or Inorganic TR/COC Record for inorganic analysis) are being used within the FORMS II Lite software. Finally, samplers should be prepared to complete the appropriate shipping cooler return documentation.

At-a-Glance:

Plan to meet documentation requirements.

- ✓ Request SMO-assigned Case and CLP Sample Numbers.
- ✓ Prepare sample cooler return documentation.
- ✓ Prepare to use the FORMS II Lite software.

Since samplers are required to use the FORMS II Lite software to prepare and submit sampling project documentation and maintain sample chain-of-custody, software users must be familiar with all emergency back up procedures that should be followed in the event of a system failure. Samplers must have access to FORMS II Lite-generated TR/COC Records at sampling events. If problems are experienced while using the FORMS II Lite software, please contact the FORMS II Lite Help Desk at 703-818-4200 from 9:00 AM - 5:00 PM ET.

In the event of a system crash, samplers must have backup hardcopies of FORMS II Lite TR/COC Records. For information regarding emergency backup procedures, please refer to the following Web site:

<http://www.epa.gov/superfund/programs/clp/trcoc.htm>

2.4.1 Request Scheduling of Analysis, SMO-assigned Case Numbers, CLP Sample Numbers, and Laboratory Contact Information

SMO-assigned Case Numbers are assigned based on a request for CLP Routine Analytical Services (RAS), which is processed through the RSCC (or his/her designee). The sampler must request the RSCC to schedule CLP RAS analysis. The CLP does have the capacity to schedule sampling on an emergency basis, however the sampler must contact the RSCC (or his/her designee) to obtain details regarding how to handle such a situation. When scheduling a sampling event that will last for more than one week, it is recommended that the sampler contact the RSCC (or his/her designee) on a weekly basis to provide updates. This contact between the sampler, the RSCC (or his/her designee), and SMO is very important because it will ensure better availability of laboratory capacity.

In addition to SMO-assigned Case and CLP Sample Numbers, samplers should make sure to have accurate laboratory contact information, such as:

- Laboratory name;
- Laboratory address;
- Contact name; and
- Laboratory phone number.

This information is used for both TR/COC Records and chain-of-custody documentation and shipping paperwork such as address labels and airbills.

The SMO-assigned Case Number is used to track groups of samples throughout the sampling and analytical processes. Samplers must correctly indicate the assigned Case Number on the appropriate sample bottle or container.



The RSCC (or his/her designee) provides the CLP Case Numbers and Sample Numbers for each sampling event to samplers. Once the CLP Sample Numbers have been provided to the sampler, the sampler can use FORMS II Lite to print them onto sample labels.

The following characters are not to be used in generating CLP Sample Numbers and should never appear on any paperwork submitted to the laboratory: I, O, U, and V.

A CLP *Sample Number* is defined as a number that is unique per sampling location and identifies each CLP sample (see Section 1.4.1.1). Since samples must be identified per analytical program (either organic or inorganic), there are two types of TR/COC Records and two letter codes to denote organic vs. inorganic analysis.

A CLP *sample* is defined as one discrete portion of material to be analyzed that is contained at one concentration level, from one station location for each individual or set of analytical fractions -- provided the fractions are all requested for the same CLP analytical service (i.e., organic or inorganic), and identified by a unique Sample Number.



When samples are collected from several station locations to form a composite sample, the composite sample should be assigned either a number from one of the station locations used during collection, or a unique number that represents the composite sample for tracking purposes. The numbering scheme used internally at a sampling event for identifying composite samples should also be documented appropriately (e.g., in the field logs).

Organic CLP Sample Numbers begin with the Regional letter code, followed by four letters and/or numbers. Inorganic CLP Sample Numbers begin with “M”, followed by the Regional letter code and then four letters and/or numbers. See Table 2-1 for Region and letter codes for each sample type (i.e., organic or inorganic).

Table 2-1. CLP Sample Number Letter Codes

Region	Letter Code	
	Organic	Inorganic
1	A	MA
2	B	MB
3	C	MC
4	D	MD
5	E	ME
6	F	MF
7	G	MG
8	H	MH
9	Y	MY
10	J	MJ

According to CLP guidelines, each individual inorganic water sample may be analyzed for total metals or dissolved metals, but not both. Therefore, water samples collected for total metal and dissolved metal analyses from the same sampling location must be assigned separate (unique) CLP Sample Numbers. A sampler can use the same CLP Sample Number for an inorganic soil or water sample collected for total metals, mercury and cyanide analyses.

Organic soil and water samples may be collected for analysis under the SOM01 SOW to detect:

- Aroclors;
- Semivolatile Organic Analytes (SVOAs);
- Pesticides;
- Volatile Organic Analytes (VOAs); and/or
- Trace Volatile Analytes

Inorganic soil and water samples may be collected for analysis for cyanide, and for metals using Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) and Cold Vapor Atomic Absorption (CVAA), under the ILM05.X SOW.

Inorganic water only samples may be collected for analysis for cyanide, and for metals using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) and CVAA, under the ILM05 SOW.

2.4.2 Prepare Sample Cooler Return Documentation

CLP laboratories must routinely return sample shipping coolers to the appropriate sampling office within 14 calendar days following receipt of shipment from the sampler. For sample coolers to be returned, the

sampler must complete the appropriate cooler documentation and work with Regions and government agencies to provide a cost-effective mechanism for laboratories to return the empty coolers to the appropriate sampling office. The sampling cooler return documentation can be prepared in advance and provided to samplers before field activities begin. **The sampler (not the CLP laboratory) is responsible for paying for return of the cooler and should also include shipping airbills bearing the sampler's account number, as well as a return address to allow for cooler return.**

To maintain consistency among cooler transportation programs, samplers should:

- Minimize the use of multiple transportation carriers to avoid confusion;
- Use multiple-copy labels so the laboratory and the sampling team can each retain a copy for their records;
- Prepare labels in advance so that the laboratory can simply affix a completed shipping label on the cooler;
- Include third-party billing information (i.e., their shipping account number) on labels so the laboratory will not be billed by the transportation carrier;
- Confirm that the laboratory knows which transportation carrier to use; and
- Include the SMO-assigned Case Number on return information.

2.5 Obtain Municipal Permits, Licenses, and Clearances

Before starting a sampling event, samplers must make sure to obtain the proper municipal permits, accesses to the property, and any government clearances, if required. The sampler must also contact any appropriate utility companies to ascertain where any underground pipes, cables, etc., may be located.

At-a-Glance:

Obtain permits, licenses, and clearances.

- ✓ Request access to County, State, Tribal, military, and/or Federal property.
- ✓ Contact private property owner(s).
- ✓ Contact utility companies.

2.5.1 Request Access to County, State, Tribal, Military, and/or Federal Property

Proper access to perform sampling activities is important not only for legal reasons, but also to eliminate delays in work and possible refusal to allow sampling to take place. It is crucial that the appropriate permits, licenses, and clearances be secured to obtain access for sampling activities that will be performed on County, State, Tribal, military, and/or Federal property. The sampler must contact the appropriate government offices or personnel well in advance to determine what kinds of approval are required. Pre-approval may be required for specific types of sample collection such as drilling or excavation. For example, drilling on a military base requires pre-approval. Base security may require clearances for all members of the sampling team, including subcontractors. This process may take two or more days.

If arrangements are not made in advance, the team may not be allowed to enter the site until their clearances are processed and the team has been approved to drill. As a result, the sampling schedule is delayed, costing extra time and money.

2.5.2 Contact Private Property Owners

The sampler must obtain written permission from the private property owner(s) before sampling on their property, even if verbal permission has been granted. It is recommended that samplers obtain verbal permission prior to their arrival at the sampling location, but written permission can be obtained on the day of sampling. If a property owner refuses to grant access to their property, it may be necessary for sampling participants to contact the appropriate authorities for assistance.

2.5.3 Contact Utility Companies

The sampler should contact local utility companies (e.g., power, phone, gas, cable, sanitation, etc.) at least one week prior to the sampling event to have underground cables, lines, and pipes flagged and marked. This is required by law. A national one-call directory can be found at:

<http://www.digsafely.com/contacts.htm>.

This will eliminate potential safety hazards and service disruption. For example, soil sampling in a residential area may require digging below the soil's surface. It is very important to know where utility lines and pipes are located so that samplers do not hit live electrical wires or rupture gas lines. Samplers should follow Regional or other appropriate program procedures for the procurement of such services. The utility service(s) disruption dates should be confirmed at least two days prior to sampling activities.



Pre-payment of survey fees to local utility companies may be required.

2.6 Identify and Obtain Sampling Materials

Samplers must make sure to be prepared for a sampling project with the appropriate sampling materials (equipment, supplies, sample containers, packing materials, and shipping materials). The equipment and supplies must be properly cleaned, calibrated, and tested as necessary to meet the needs of the sampling project.

At-a-Glance:

Identify and obtain sampling materials.

- ✓ Procure appropriate equipment and supplies.
- ✓ Procure sample containers.
- ✓ Procure shipping supplies.

2.6.1 Procure Appropriate Equipment and Supplies

Each sampling event requires the procurement of equipment and materials to collect, document, identify, pack, and ship samples. The proper field sampling equipment is vital to a successful sample collection. Regional or other samplers should obtain, and arrange in advance, all of the equipment and supplies required for each sampling event. Samplers should review the project plans to verify that the proper equipment is being used for sample collection.

At a minimum, the following materials are generally required during a sampling event:

- Sample storage containers;
- Packing material;
- Sample containers;
- Shipping containers;
- Access to the FORMS II Lite software for creating sample labels, stickers, tags, and TR/COC Records;
- Custody seals; and
- Sampling equipment such as bowls, augers, pumps, etc.

Sampling events may also require specific items such as:

- Cooler temperature blanks;
- Trip blanks for VOA analysis;
- Preservation supplies (e.g., ice or acid); and
- Specially prepared sample vials (e.g., for SW-846 Method 5035A).

2.6.2 Procure Sample Containers

The analytical protocol(s) to be used for sample analysis often requires the use of a particular type of sample container. The type of container also may depend on the sample matrix and analysis. It is recommended that samplers use borosilicate glass containers, which are inert to most materials, when sampling for pesticides and/or other organics. Conventional polyethylene is recommended when sampling for metals because of the lower cost and absorption rate of metal ions.

Using the wrong container may result in breakage, gathering of an insufficient volume needed to perform sample analysis, or the container material may interfere with the analysis. Therefore, samplers should identify and use the correct sample containers for each sampling event.

Containers procured for a sampling event are usually pre-cleaned and shipped ready-for-use from the manufacturer to the sampling site. Regardless of the type of container used, samplers must ensure that the containers have been analyzed or certified clean to levels below concern for the project. These containers must meet the USEPA container type specifications listed in Table 2-2.

Table 2-2. Container Type Specifications

Reference Number	Container Type	Specifications	
		Closure	Septum
1	40 mL amber glass vial, 24 mm neck finish.	Polypropylene or phenolic, open-top screw-cap, 15 mm opening, 24-400 size.	24 mm disc of 0.005 in. Polytetrafluoroethylene (PTFE) bonded to 0.120 in. silicone for total a thickness of 0.125 in.
2	1 L high density polyethylene, cylinder-round bottle, 28 mm neck finish.	Polyethylene cap, ribbed, 28-410 size; F217 polyethylene liner.	N/A
3	8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish.	Polypropylene or phenolic cap, 70-400 size; 0.015 in. PTFE liner.	N/A
4	4 oz (120 mL) tall, wide mouth, straight-sided, glass jar, 48 mm neck finish.	Polypropylene or phenolic cap, 48-400 size; 0.015 in. PTFE liner.	N/A
5	1 L amber round glass bottle, 33 mm pour-out neck finish.	Polypropylene or phenolic cap, 33-430 size; 0.015 in. PTFE liner.	N/A
6	500 mL high density polyethylene, cylinder-round bottle, 28 mm neck finish.	Polypropylene cap, ribbed, 28-410 size; F217 polyethylene liner.	N/A
7	Coring tool used as a transport device (e.g., 5 g Sampler).	Has built-in closing mechanism.	N/A
8	250 mL high density polyethylene, cylinder-round bottle, 28 mm neck finish.		N/A

The information contained in this table is also cross-referenced in the sample collection parameters discussed in Chapter 3. The container Reference Numbers are used in Tables 3-2 and 3-3 under the Containers column. For example, samples collected for low-level soil VOA analysis using SW-846 Method 5035A may require the sampler to use pre-prepared, tared closed-system purge-and-trap vials with a preservative (refer to Appendix B).



Have extra containers readily available for each sampling event in case of breakage, loss, or contamination.

2.6.3 Procure Shipping Supplies

Samples should be correctly packaged into the appropriate shipping containers to reduce the risk of breakage or leakage, and the shipping containers should be appropriately prepared for shipment. Before heading into the field, samplers should refer to the appropriate project plans to determine the types of samples that will be taken during the sampling project so that samplers will have the proper packaging materials at the site for all pertinent samples container types and sample matrices. Samplers should also make sure to obtain the appropriate shipping paperwork (e.g., shipping forms required by the delivery service).

2.7 Comply with Transportation and Shipping Requirements

Samplers are expected to review the applicable project plans to be aware of all State, Federal, Department of Transportation (DOT), and International Air Transport Association (IATA) regulations governing environmental and hazardous sample packaging. The person who ships the samples is responsible for being in compliance with applicable packaging, labeling, and shipping requirements.



Samplers should request and receive sample permits for outside the continental United States, prior to shipping.

Additional information can be obtained on Hazardous Materials Safety Program regulations from the DOT's Research and Special Programs Administration. Federal transportation regulations can be found in 49-CFR Parts 100-185, are available on the Internet at:

<http://www.myregs.com/dotrspa/>

2.8 Provide Shipment Notification

Some Regions may require that samplers notify their RSCC (or his/her designee) when samples are shipped. Some Regions allow samplers to contact SMO directly to provide shipment notification. It is recommended that samplers contact the RSCC of sample origin to verify if such notification is necessary. If samplers are shipping samples after 5:00 PM ET, samplers must notify the RSCC (or designee) or SMO by 8:00 AM ET on the following business day.



For Saturday delivery at the laboratory, samplers **MUST** contact the RSCC (or designee) or SMO so that SMO will receive the delivery information by 3:00 PM ET on the Friday prior to delivery.

2.9 Perform Readiness Review/Dry Run

A readiness review/dry run is a test run of the proposed sampling event. This is a recommended practice since it gives samplers a chance to check all plans, documentation software (i.e., FORMS II Lite), and equipment lists for accuracy and completeness prior to sampling activities. It also provides an opportunity to consult with sampling team members to make sure all the elements are in place and everyone understands their tasking before actually going out to the field. Sampling project managers should provide the test or dry run dates and schedules to samplers so that samplers can prepare accordingly.

3.0 IN-FIELD ACTIVITIES

This chapter addresses the in-field activities a sampler will focus on during a sampling event such as: determining the type of samples to be collected; collecting the samples; meeting volume, preservation, and holding time requirements; completing documentation; and packing and shipping samples.

When performing a sampling event, the sampler is expected to follow prescribed sampling techniques. The sampler should also be aware of any special sampling considerations, contamination issues, and sample compositing and mixing methods that could affect their sampling efforts. Please refer to Appendix D for more detailed information.

At-a-Glance: In-field Activities

- ✓ Collecting samples
- ✓ Completing documentation
- ✓ Sampling considerations
- ✓ Procuring shipping supplies



Appropriate Regional guidance and procedures should be consulted for detailed sample collection, preservation, handling and storing, equipment decontamination, and QA/QC procedures.

3.1 Collect Samples

CLP RAS are generally used to analyze samples from Superfund sites. The matrices can be water, soil, or sediment. In some instances, a mixed-matrix sample may be collected which contains either a supernate (for a sediment/soil sample) or a precipitate (for a water sample). In this event, samplers should consult their management plans and/or discuss the required procedures with the RSM or their designee.

A CLP sample consists of all sample aliquots (portions):

- for each individual or set of analytical fractions;
- from one station location;
- for one sample matrix;
- at one concentration level;
- for one laboratory; and
- for one analytical program;

provided that the fractions are all requested from the same CLP analytical service.

In general, it is recommended that two individual samples be collected by separating the aqueous layer from the solid/precipitate layer at the point of collection. They may be assigned two different sample IDs (e.g., Sample IDs ABC124 and ABC125 for Sample ID ABC123), along with a note in the field sample log or tracking system that the sample IDs are derived or related to the same sample ID, to ensure correct follow-up upon receipt of results from the laboratory. Alternatively, they may be assigned the same sample ID, along with a notation of each individual sub-sample or fraction (e.g., Sample IDs ABC123-1 and ABC123-2 or Sample ID ABC123 Fraction 1 and Sample ID ABC123 Fraction 2 for Sample ID ABC123).

3.1.1 Determine Types of Samples to be Collected

Samplers may be required to take several types of samples or sample aliquots during a sampling event. They should refer to their project plans to determine the types of samples or aliquots to be taken, the volumes needed of each sample or aliquot, and the preservation needed for each sample. For an explanation of the various sample types and the requirements for collecting and submitting each particular type, refer to Table 3-1.

Table 3-1. QC Sample Types and CLP Submission Requirements

Sample Type	Purpose	Collection ¹	CLP Sample Number
Field Duplicate	To check reproducibility of laboratory and field procedures. To indicate non-homogeneity.	Collect from areas that are known or suspected to be contaminated. Collect one sample per week or 10% (Regions may vary) of all field samples per matrix, whichever is greater.	Assign two separate (unique) CLP Sample Numbers (i.e., one number to the field sample and one to the duplicate). Submit blind to the laboratory.
Field Blanks	To check cross-contamination during sample collection, preservation, and shipment, as well as in the laboratory. Also to check sample containers and preservatives.	Collect for each group of samples of similar matrix per day of sampling. Organics - Use water (demonstrated to be free of the contaminants of concern). Inorganics - Use metal-free (deionized or distilled) water.	Assign separate CLP Sample Numbers to the field blanks.
Trip Blank (Volatile Organic Analysis Only)	To check contamination of VOA samples during handling, storage, and shipment from field to laboratory.	Prior to going into the field, prepare and seal one sample per shipment per matrix using water demonstrated to be free of the contaminants of concern (deionized water is appropriate). Place this sample in the cooler used to ship VOA samples.	Assign separate CLP Sample Numbers to the trip blanks.
Equipment Blank or Rinsate Blank	To check field decontamination procedures.	Collect when sampling equipment is decontaminated and reused in the field or when a sample collection vessel (bailer or beaker) will be used. Use blank water (water demonstrated to be organic-free, deionized or distilled for inorganics) to rinse water into the sample containers.	Assign separate CLP Sample Numbers to the equipment blanks.
Matrix Spike (MS) and Duplicate (MSD) ² (Organic Analysis Only)	To check accuracy and precision of organic analyses in specific sample matrices.	Collect from areas that are known or suspected to be contaminated. For smaller sampling events (i.e., 20 samples or less), MS/MSD additional volume should be collected in the first round of sampling and included in the first shipment of samples to the laboratory. Collect double or triple volume ³ for aqueous samples and soil VOA samples designated for MS/MSD analyses. Additional sample volume is not required for soil samples requiring SVOA, Pesticide, and/or Aroclor analysis. See Appendix B for VOA collection volumes.	Assign the same CLP Sample Number to the field sample and the extra volume for MS/MSD. Identify the sample designated for MS/MSD on the TR/COC Record.
Matrix Spike (MS) and Duplicate (MSD) (Inorganic Analysis Only)	To check accuracy and precision of inorganic analyses in specific sample matrices.	Collect from areas that are known or suspected to be contaminated. For smaller sampling events (i.e., 20 samples or less), Matrix Spike and Duplicates should be collected in the first round of sampling and included in the first shipment of samples to the laboratory. Additional sample volume may be required for inorganic analysis. ⁴	Assign the same CLP Sample Number to the field sample and extra volume (if collected). Identify the sample(s) designated for Matrix Spike and Duplicates on the TR/COC Record.
PE Samples	Specially-prepared QC samples used to evaluate a laboratory's analytical proficiency.	The PE samples contain analytes with concentrations unknown to the laboratory. Designated Regional or authorized personnel (depending on Regional policy) arrange for Case-specific CLP PE samples to be prepared and shipped by the QATS contractor. The PE samples can be shipped to the site, or shipped per Regional direction. QATS provides the appropriate preparation instructions and chain-of-custody materials.	Samplers have no direct interaction with the PE sampling process, but should be aware that such samples do exist within the CLP sampling process. Samplers must, however, order PE samples and ship them to the laboratory if required by the Region.

¹ Consult Regional or Project Manager Guidance for field QC sample frequencies; laboratory QC sample frequencies are generally fixed in the laboratory subcontracts or specified in analytical methods. Current frequency for MS/MSD (organic) and MS/duplicate (inorganic) for the CLP is one sample per twenty field sample of similar matrix.

² Samples sent under the Organic SOW (SOM01) do not require an MS or MSD for Trace VOA, VOA and BNA fractions, but the Region may opt to send them at their discretion.

³ Example of double volume: An aqueous sample for SVOA analysis would require the field sampler to collect at least 2 L of field sample and at least 1 L each for the MS and MSD samples for a total volume of 4 L. If Pesticide or Aroclor MS/MSD analyses are required for the same sample, an additional 4 L must be collected. Double volume is the MINIMUM allowable volume for samples designated for MS/MSD analysis. Triple volume may be sent for MS/MSD samples to allow for sufficient volume for these analyses in the event sample volume is lost as a result of samples breaking, leaking, or laboratory accidents.

⁴ Double volume may be sent for inorganic aqueous MS and MSD samples to allow for sufficient volume for these analyses in the event sample volume is lost as a result of samples breaking, leaking or laboratory accidents.

3.1.1.1 Collect Field QC Samples

Samplers can collect field QC samples and laboratory QC samples to verify that sample quality is maintained during a sampling project.

Field QC samples are designed to assess variability of the media being sampled and to detect contamination and sampling error in the field. The types of field QC samples that are generally collected include field duplicates and field blanks (such as equipment, trip, or rinse blanks). Generally, field duplicate samples should remain “blind” to the laboratory (i.e., they should have separate CLP Sample Numbers).

3.1.1.2 Collect Laboratory QC Samples

A laboratory QC sample is an additional analysis of a field sample, as required by the laboratory’s contract. There are three types of laboratory QC samples:

- MS [for organic and inorganic samples];
- MSD [for organic samples only]; and
- Duplicates [for inorganic samples only].



Samplers should obtain Regional guidance regarding the collection of MS and MSD samples (especially for organics analyses).

Samplers should select one sample per matrix per 20 samples as a “laboratory QC” sample. Designated organic laboratory QC samples should be noted on the Organic TR/COC Record. Designated inorganic laboratory QC samples should be noted on the Inorganic TR/COC Record. The laboratory QC sample must not be designated only in the “Field QC Qualifier” column on either the Organic or Inorganic TR/COC Records. Make sure that the laboratory QC sample is included in TR/COC Record samples to be used for the Laboratory QC field.

The sampler should select a field sample as the laboratory QC sample. If the sampler does not select a field sample as the laboratory QC sample, then it is possible that the laboratory could select the field blank (e.g., an equipment or rinsate blank) sample to meet contractual QC requirements. The use of field blanks for laboratory MS/MSD/Duplicate analysis reduces the usability of the data to assess data quality.



In the event of multiple sample shipments during a sampling event, it is recommended that the sampler submit laboratory QC samples in the first sample shipment.

3.1.2 Meet Volume, Preservation, and Holding Time Requirements

Samplers should refer to their project plans to obtain the specific sample volumes to be collected, the preservation needed for those samples, and the technical holding times under which they must submit samples to the scheduled CLP laboratory. Sample collection parameters (to include sample volumes, preservatives, and technical holding times) for organic collection and analysis are listed in Tables 3-2 and 3-3. Sample collection parameters for inorganic analysis and collection are listed in Table 3-4.

3.1.2.1 Collect Sample Volume

Collecting sufficient sample volume is critical. There must be sufficient physical sample volume for the analysis of all required parameters and completion of all QC determinations. The type of analytical procedure(s) to be performed will often dictate the sample volume to collect. For example, each water sample collected for VOA analysis by CLP SOW SOM01 or ILM05 requires a minimum of three vials, each filled completely to a 40 mL capacity. See Appendix C for information regarding the collection of VOAs in water. It is extremely important that samplers refer to their specific project plans to identify and collect the correct sample volume during each sampling event.

When sampling for VOAs in soils, samplers must use SW-846 Method 5035A guidelines included in Appendix B.

3.1.2.2 Preserve Samples

Degradation of some contaminants may occur naturally (e.g., VOAs). The sampler must chemically preserve some water samples for certain analytes before shipping them to the laboratory. The sampler should preserve and immediately cool all samples to 4°C ($\pm 2^\circ\text{C}$) upon collection and samples should remain cooled until the time of analysis (do not freeze water samples). Preservation techniques vary among Regions so the sampler should obtain Region-specific instructions and review the appropriate project plans and SOPs. See Appendix C for information regarding the collection of VOAs in water.

3.1.2.3 Ship within Holding Times

Samplers should ship samples to scheduled CLP laboratories as soon as possible after collection. Daily shipment of samples to CLP laboratories is preferred whenever possible. If samples cannot be shipped on a daily basis, they must be properly preserved and maintained to meet CLP-specified temperatures, holding times, and custody requirements.

The technical holding times are the maximum time allowed between a sample collection and the completion of the sample extraction and/or analysis. In contrast, contractual holding times are the maximum lengths of time that the CLP laboratory can hold the sample prior to extraction and/or analysis. These contractual holding times are described in the appropriate CLP SOW. Contractual holding times are shorter than the technical holding times to allow for sample packing and shipping.



If samplers are shipping samples after 5:00 PM ET, they must notify the RSCC (or designee) or SMO by 8:00 AM ET on the following business day. When making a Saturday delivery, samplers shall contact the RSCC (or designee) or SMO by 3:00 PM ET on the Friday prior to delivery.

Table 3-2. Sample Collection Requirements for CLP SOW SOM01 (VOAs)

Matrix	Container Type	Sample Type	Minimum Number of Containers Needed				Minimum Volume/Mass	Important Notes	Preservative	Technical Holding Time
			with Water	Dry	% Moisture	TOTAL				
Water	See Table 2-2, Reference Number 1.	Samples Only	-	-	-	3	Fill to capacity	Containers/vials must be filled to capacity with no headspace or air bubbles. Refer to Appendix C for samples requiring QC analyses.	Preserve to a pH of 2 with HCl and cool to 4°C (±2°C) immediately after collection. DO NOT FREEZE water samples.	14 days
		Samples with SIM	-	-	-	4				
		Samples with MS/MSD	-	-	-	6				
		Samples with SIM and MS/MSD	-	-	-	8				
Soil/ Sediment	OPTION 1 Closed-system Vials See Table 2-2, Reference Number 1.	Samples Only	-	3	1	4	5g	Place samples on side prior to being frozen. Refer to Appendix B for samples requiring QC analyses.	Frozen (-7°C to -15°C) or iced to 4° (±2°C).	14 days
		Samples with MS/MSD	-	9	1	10				48 hours
	OPTION 2 Closed-system Vials containing Water See Table 2-2, Reference Number 1.	Samples Only	2	1	1	4	5g	Containers/vials must be filled to capacity with no headspace or air bubbles. Place samples on side prior to being frozen. Refer to Appendix B for samples requiring QC analyses.	Frozen (-7°C to -15°C) or iced to 4° (±2°C). DO NOT FREEZE water samples.	14 days
		Samples with MS/MSD	6	1	5	12				48 hours
	OPTION 3 See Table 2-2, Reference Number 7.	Samples Only	-	3	1	4	5g	Refer to Appendix B for samples requiring QC analysis.	Frozen (-7°C to -15°C) or iced to 4°C (±2°C).	48 hours
		Samples with MS/MSD	-	9	1	10				48 hours

Notes

- ¹ Minimum volume/mass to be collected in order to ensure sample analysis can be performed.
- ² Check Regional guidance regarding use of acid as a preservative of samples that may contain carbonates, residual chlorine, and other oxidants.
- ³ This technical holding time is calculated from the time of sample collection to sample extraction. Sample extracts are to be analyzed within 40 days of extraction. It is recommended that samplers ship samples to the laboratory on the same day that they are collected, or as soon as possible thereafter.
- ⁴ Check Regional guidance regarding use of acid preservatives when testing for carbonates, residual chlorine, and other oxidants.

Table 3-3. Sample Collection Requirements for CLP SOW SOM01 (SVOAs, Pesticides and Aroclors)

Analysis	Matrix	Containers	Minimum Volume/ Mass	Important Notes	Preservative	Technical Holding Time
Semivolatile Analytes	Water	See Table 2-2, Reference Number 5.	2L	If amber containers are not available, the samples should be protected from light.	Cool all samples to 4°C (±2°C) immediately after collection. DO NOT FREEZE water samples.	7 days
	Soil/ Sediment	See Table 2-2, Reference Numbers 3 and 4.	Fill to capacity		Cool all samples to 4°C (±2°C) immediately after collection.	14 days
Pesticides/ Aroclors	Water	See Table 2-2, Reference Number 5.	2L	If amber containers are not available, the samples should be protected from light.	Cool all samples to 4°C (±2°C) immediately after collection. DO NOT FREEZE water samples.	7 days
	Soil/ Sediment	See Table 2-2, Reference Numbers 3 and 4.	Fill to capacity		Cool all samples to 4°C (±2°C) immediately after collection.	14 days

Notes

- ¹ Minimum volume/mass to be collected in order to ensure sample analysis can be performed.
- ² Check Regional guidance regarding use of acid as a preservative of samples that may contain carbonates, residual chlorine, and other oxidants.
- ³ This technical holding time is calculated from the time of sample collection to sample extraction. Sample extracts are to be analyzed within 40 days of extraction. It is recommended that samplers ship samples to the laboratory on the same day that they are collected, or as soon as possible thereafter.
- ⁴ Check Regional guidance regarding use of acid preservatives when testing for carbonates, residual chlorine, and other oxidants.

Table 3-4. Sample Collection Requirements for CLP SOW ILM05

Analysis	Matrix	Containers	Minimum Volume/ Mass ¹	Important Notes	Preservative	Technical Holding Time ⁴
Metals/ICP-AES and/or Mercury by CVAA	Water	See Table 2-2, Reference Number 2.	1L	If collecting for both ICP-AES AND ICP-MS methods, a separate 1L volume of sample must be collected for each method per sample location.	Acidify to pH < 2 with HNO ₃ and cool to 4°C (±2°C) immediately after collection. ² NOT FREEZE water samples. DO	6 months for all metals except Mercury (28 days)
	Soil/ Sediment	See Table 2-2, Reference Number 3.	Fill to capacity		Cool to 4°C (±2°C) immediately after collection.	6 months
Cyanide/ Spectrophotometric Determination ³	Water	See Table 2-2, Reference Number 2.	1L		To neutralize residual chlorine, immediately upon collection, add 0.6 g ascorbic acid for each liter of sample collected. Add NaOH until pH >12 and cool to 4°C (±2°C) immediately after collection. ⁵ DO NOT FREEZE water samples.	14 days
	Soil/ Sediment	See Table 2-2, Reference Number 3.	Fill to capacity		Cool to 4°C (±2°C) immediately after collection.	14 days

Notes

¹ Minimum volume/mass to be collected in order to ensure sample analysis can be performed.

² Check Regional guidance regarding use of acid as a preservative of samples that may contain carbonates, residual chlorine, and other oxidants.

³ Samplers must test for sulfide and oxidizing agents (e.g., chlorine) in aqueous samples in the field upon collection. Please refer to the SAP and Appendix C for guidance. Sulfides adversely affect the analytical procedure. The following can be done to test for and neutralize sulfides. Place a drop of the sample on lead acetate test paper to detect the presence of sulfides. If sulfides are present, treat 25 mL more of the sample than that required for the cyanide determination with powdered cadmium carbonate or lead carbonate. Yellow cadmium sulfide or black lead sulfide precipitates if the sample contains sulfide. Repeat this operation until a drop of the treated sample solution does not darken the lead acetate test paper. Filter the solution through a dry filter paper into a dry beaker, and from the filtrate measure the sample to be used for analysis. Avoid a large excess of cadmium carbonate and a long contact time in order to minimize a loss by complication or occlusion of cyanide on the precipitated material. Sulfide removal should be performed in the field, if practical, prior to pH adjustment with NaOH.

⁴ This technical holding time is calculated from the time of sample collection to sample extraction. Sample extracts are to be analyzed within 40 days of extraction. It is recommended that samplers ship samples to the laboratory on the same day that they are collected, or as soon as possible thereafter.

3.2 Complete Documentation

Samplers must complete all documentation, including the recording of the CLP Sample Number on the sample container or bottle, sample labels, and chain-of-custody seals (as appropriate), the completion of the TR/COC Record, and the completion of field operations records (as necessary).

Samplers should use the FORMS II Lite software to create and print sample labels and the TR/COC Record. Samplers can create and print out two copies of a sample label and attach one to the sample container or bottle, and place the other on the sample tag that may be attached to the sample container or bottle.

Samplers are expected to review their project plans to determine what documentation they are expected to include during a sampling event. It is highly recommended that samplers provide documentation, even if the Region does not require it.



Under no circumstances should the site name appear on any documentation being sent to the laboratory.

An example of a packaged sample is shown in Figure 3-1. A description of each type of documentation and instructions for accurate completion are included in the following sections.

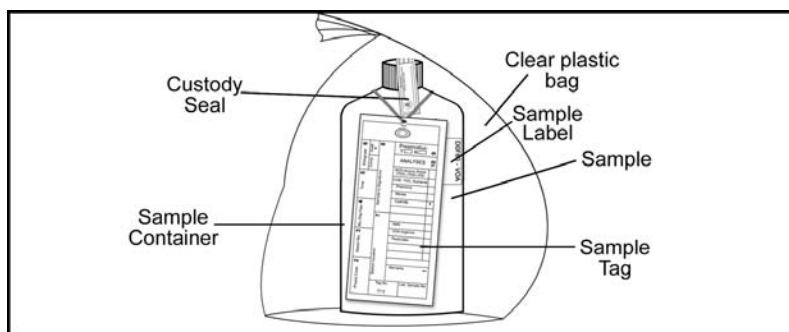


Figure 3-1. Packaged Sample with Identification and Chain-of-Custody Documentation (Excluding TR/COC Record)

3.2.1 Identify a Sample with a CLP Sample Number and SMO-assigned Case Number

The CLP Sample Number and SMO-assigned Case Number **must** be recorded on each sample taken during a sampling event (see Section 1.4.1.1). Samplers can record these numbers on the sample bottle or container using permanent ink. The numbers must also be recorded on the sample tag, if required.



Dissolved metal samples and total metal samples taken from the same sampling location cannot have the same CLP Sample Number because two different sets of data will be generated.

3.2.2 Complete TR/COC Records

A Traffic Report is used as physical evidence of sample custody and as a permanent record for each sample collected. A chain-of-custody record documents the exchange and transportation of samples from the field to the laboratory.

The ASB requires samplers to use the FORMS II Lite software to create documentation for all CLP sampling efforts. For assistance with obtaining or using the FORMS II Lite software, please contact the FORMS II Lite Help Desk at 703-818-4200 from 9:00 AM - 5:00 PM ET.

To meet CLP sample documentation and chain-of-custody requirements, the sampler must attach a separate TR/COC Record to each cooler they ship. The TR/COC Record must document each sample within the cooler. Samples shipped in other coolers should not be documented. This practice maintains the chain-of-custody for all samples in case of incorrect shipment.

If more than one TR/COC Record is used for the samples within one cooler, all of the records must have complete header information and original signatures. Samplers are responsible for the care and custody of samples from the time of collection to the time of shipment to the laboratories for analysis. A sample is considered under custody if:

- It is in possession or in view after being in possession;
- It was in possession and then secured or sealed to prevent tampering; or
- It was in possession when placed in a secured area.

Each time the custody of samples is turned over to another person, the TR/COC Record must be signed off by the former custodian and accepted by the new custodian. Samplers are, therefore, responsible for properly completing any forms or other Region-required documentation used to establish the chain-of-custody for each sample during a sampling event.

3.2.2.1 Complete a TR/COC Record Using the FORMS II Lite Software

Once the sampler inputs sample collection information into FORMS II Lite, a TR/COC Record will be generated electronically. The software automatically displays only the information to be entered by the sampler. FORMS II Lite then generates a laboratory and a Regional copy of the TR/COC Record (see Figures 3-2 through 3-5). The sampler can print out multiple copies of the TR/COC Record as necessary. The sampler must sign and submit original copies of the TR/COC Record as appropriate.

An electronic TR/COC Record created using the FORMS II Lite software contains basic header information; however, the sampler can also include some additional detailed information. For example, not only is the sample matrix listed on the electronic TR/COC Record, but the name of the sampler taking the sample can also be entered. Samplers should note that certain information will not appear on the electronic TR/COC Record (e.g., matrix and preservative descriptions).

3.2.2.2 Indicate Modified Analysis on FORMS II Lite TR/COC Records

When completing a TR/COC Record using FORMS II Lite, the sampler should identify any samples that will be analyzed using a CLP Modified Analysis. Samplers should indicate use of a Modified Analysis by creating a new analysis within the FORMS II Lite Wizard or through the FORMS II Lite Reference Tables. This newly-created analysis should contain the Modification Reference Number within the name assigned to the analysis. For example, if a Region submits a Modified Analysis for an additional analyte, and SMO assigns the Modification Reference Number 1301.0, the FORMS II Lite analysis could be named "VOA by M.A. 1301.0". The associated abbreviation for this analysis could be "VOA M.A.". If you have any questions regarding identification of Modified Analysis using FORMS II Lite, please contact the FORMS II Lite Help Desk at 703-818-4200 from 9:00 AM - 5:00 PM ET.

3.2.2.3 Make Manual Edits to Printed FORMS II Lite TR/COC Records

If a FORMS II Lite TR/COC Record has been printed and deletions or edits need to be made by the sampler, the following procedures must be followed:

- If making a deletion, manually cross out the information to be disregarded from the TR/COC Record, initial and date the deletion.
- If making an addition, enter the new information and initials and date the newly added information.



All modifications made on a printed TR/COC Record must be initialed and dated.

USEPA Contract Laboratory Program Organic Traffic Report & Chain of Custody Record						Case No: 39400 DAS No: DAS9000 SDG No:		L																	
Date Shipped: 2/20/2001 Carrier Name: DHL Airbill: 121212 Shipped to: Organic Laboratory 1234 Smith Drive Anywhere, USA 12345 (123) 456-7890		Chain of Custody Record <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 40%;">Relinquished By</th> <th style="width: 20%;">(Date / Time)</th> <th style="width: 40%;">Received By</th> <th style="width: 20%;">(Date / Time)</th> </tr> <tr><td>1</td><td></td><td></td><td></td></tr> <tr><td>2</td><td></td><td></td><td></td></tr> <tr><td>3</td><td></td><td></td><td></td></tr> <tr><td>4</td><td></td><td></td><td></td></tr> </table>		Relinquished By	(Date / Time)	Received By	(Date / Time)	1				2				3				4				For Lab Use Only Lab Contract No: _____ Unit Price: _____ Transfer To: _____ Lab Contract No: _____ Unit Price: _____	
Relinquished By	(Date / Time)	Received By	(Date / Time)																						
1																									
2																									
3																									
4																									
ORGANIC SAMPLE No.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNAROUND	TAG No./ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME		INORGANIC SAMPLE No.	FOR LAB USE ONLY Sample Condition On Receipt																
C0075	Industrial Process Wastewater/ BOBBY SAMPLER	H/C	BNA/PEST (21), VOA 6486, 6487 (2)		LOCATION ONE	S: 2/20/2001 E: 2/23/2001	16:02 16:02	MC0075																	
C0076	Ground Water/ JOE SAMPLER	L/C	BNA/PEST (21), VOA 6494, 6495 (2)		LOCATION TWO	S: 2/20/2001 E: 2/21/2001	16:01 16:01	MC0076																	
C0077	Industrial Effluent Wastewater/ JOE SAMPLER	M/G	BNA/PEST (21), VOA 6502, 6503 (2)		LOCATION ONE	S: 2/16/2001 E: 2/20/2001	15:55 15:55	MC0077																	

Shipment for Case Complete? <input checked="" type="checkbox"/>	Sample(s) to be used for laboratory QC: C0077	Additional Sampler Signature(s):	Cooler Temperature Upon Receipt:	Chain of Custody Seal Number:
Analysis Key: Concentration: L = Low, M = Low/Medium, H = High BNA/PEST = CLP TCL Semivolatiles and Pesticides/PC, VOA = CLP TCL Volatiles		Type/Designate: Composite = C, Grab = G		Custody Seal Intact? <input type="checkbox"/> Shipment Iced? <input type="checkbox"/>

TR Number: 3-103823254-022001-0001

PR provides preliminary results. Requests for preliminary results will increase analytical costs.
 Send Copy to: Sample Management Office, Attn: Heather Bauer, CSC, 15000 Conference Center Dr., Chantilly, VA 20151-3819; Phone 703/818-4200; Fax 703/818-4602

LABORATORY COPY

FZV5.1.047 Page 1 of 1

Figure 3-2. Organic Traffic Report & Chain of Custody Record (Laboratory Copy)

USEPA Contract Laboratory Program Inorganic Traffic Report & Chain of Custody Record						Case No: 39400 DAS No: DAS9000 SDG No:		L	
Date Shipped: 2/20/2001 Carrier Name: DHL Airbill: 121212 Shipped to: Inorganic Laboratory 1234 Smith Drive Anywhere, USA 12345 (123) 456-7890			Chain of Custody Record			Sampler Signature: Received By: (Date / Time)		For Lab Use Only	
			Relinquished By (Date / Time)			Received By (Date / Time)		Lab Contract No: _____ Unit Price: _____ Transfer To: _____ Lab Contract No: _____ Unit Price: _____	
			1						
			2						
			3						
			4						

INORGANIC SAMPLE No.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNAROUND	TAG No./ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME		ORGANIC SAMPLE No.	FOR LAB USE ONLY Sample Condition On Receipt
MC0075	Industrial Process Wastewater/ BOBBY SAMPLER	H/C	Al (21), Ba (21), Ca (21), Cr (21), TM/CN (21)	6481, 6482, 6483, 6484, 6485 (5)	LOCATION ONE	S: 2/20/2001 E: 2/23/2001	16:02 16:02	C0075	
MC0076	Ground Water/ JOE SAMPLER	L/C	Al (21), Ba (21), Ca (21), Cr (21), TM/CN (21)	6489, 6490, 6491, 6492, 6493 (5)	LOCATION TWO	S: 2/20/2001 E: 2/21/2001	16:01 16:01	C0076	
MC0077	Industrial Effluent Wastewater/ JOE SAMPLER	M/G	Al (21), Ba (21), Ca (21), Cr (21), TM/CN (21)	6497, 6498, 6499, 6500, 6501 (5)	LOCATION ONE	S: 2/16/2001 E: 2/20/2001	15:55 15:55	C0077	

Shipment for Case Complete? <input type="checkbox"/>	Sample(s) to be used for laboratory QC: MC0077	Additional Sampler Signature(s):	Cooler Temperature Upon Receipt:	Chain of Custody Seal Number:
Analysis Key:		Concentration: L = Low, M = Low/Medium, H = High		Type/Designate: Composite = C, Grab = G
		Custody Seal Intact? <input type="checkbox"/>		Shipment Iced? <input type="checkbox"/>

Al = Aluminum, Ba = Barium, Ca = Calcium, Cr = Chromium, TM/CN = CLP TAL Total Metals and Cyanide

TR Number: 3-103823254-022001-0003

PR provides preliminary results. Requests for preliminary results will increase analytical costs.
 Send Copy to: Sample Management Office, Attn: Heather Bauer, CSC, 15000 Conference Center Dr., Chantilly, VA 20151-3819; Phone 703/818-4200; Fax 703/818-4602

LABORATORY COPY

F2V5.1.047 Page 1 of 1

Figure 3-3. Inorganic Traffic Report & Chain of Custody Record (Laboratory Copy)

USEPA Contract Laboratory Program Organic Traffic Report & Chain of Custody Record						Case No: 39400 DAS No: DAS9000		R																					
Region: 3 Project Code: QW-123 Account Code: ACCT000 CERCLIS ID: Spill ID: ID3 Site Name/State: REAL SITE, UT Project Leader: DAN SAMPLER Action: Other Sampling Co: SMITH CO.			Date Shipped: 2/20/2001 Carrier Name: DHL Airbill: 121212 Shipped to: Organic Laboratory 1234 Smith Drive Anywhere, USA 12345 (123) 456-7890			Chain of Custody Record <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 50%;">Relinquished By</th> <th style="width: 50%;">(Date / Time)</th> </tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> </table>		Relinquished By	(Date / Time)									Sampler Signature: <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 50%;">Received By</th> <th style="width: 50%;">(Date / Time)</th> </tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> </table>		Received By	(Date / Time)								
Relinquished By	(Date / Time)																												
Received By	(Date / Time)																												
ORGANIC SAMPLE No.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNAROUND	TAG No./ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME	INORGANIC SAMPLE No.	QC Type																					
C0075	Industrial Process Wastewater/ BOBBY SAMPLER	H/C	BNA/PEST (21), VOA (21)	6486, 6487 (2)	LOCATION ONE	S: 2/20/2001 16:02 E: 2/23/2001 16:02	MC0075	--																					
C0076	Ground Water/ JOE SAMPLER	L/C	BNA/PEST (21), VOA (21)	6494, 6495 (2)	LOCATION TWO	S: 2/20/2001 16:01 E: 2/21/2001 16:01	MC0076	Spike																					
C0077	Industrial Effluent Wastewater/ JOE SAMPLER	M/G	BNA/PEST (21), VOA (21)	6502, 6503 (2)	LOCATION ONE	S: 2/16/2001 15:55 E: 2/20/2001 15:55	MC0077	--																					

Shipment for Case Complete? N	Sample(s) to be used for laboratory QC: C0077	Additional Sampler Signature(s):	Chain of Custody Seal Number:
Analysis Key: Concentration: L = Low, M = Low/Medium, H = High Type/Designate: Composite = C, Grab = G BNA/PEST = CLP TCL Semivolatiles and Pesticides/PC, VOA = CLP TCL Volatiles			
Shipment Iced? _____			

TR Number: 3-103823254-022001-0001
 PR provides preliminary results. Requests for preliminary results will increase analytical costs.
 Send Copy to: Sample Management Office, Attn: Heather Bauer, CSC, 15000 Conference Center Dr., Chantilly, VA 20151-3819; Phone 703/818-4200; Fax 703/818-4602

REGION COPY

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Figure 3-4. Organic Traffic Report & Chain of Custody Record (Region Copy)

USEPA Contract Laboratory Program Inorganic Traffic Report & Chain of Custody Record						Case No: Y6767 DAS No: DAS9000		R																					
Region: 3 Project Code: QW-123 Account Code: ACCT000 CERCLIS ID: Spill ID: ID3 Site Name/State: REAL SITE, UT Project Leader: DAN SAMPLER Action: Other Sampling Co: SMITH CO.			Date Shipped: 2/20/2001 Carrier Name: DHL Airbill: 121212 Shipped to: Clayton Environmental Consultants, Inc 22345 Roethel Drive Novi MI 48375 (248) 344-1770			Chain of Custody Record <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 50%;">Relinquished By</th> <th style="width: 50%;">(Date / Time)</th> </tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> </table>		Relinquished By	(Date / Time)									Sampler Signature: <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 50%;">Received By</th> <th style="width: 50%;">(Date / Time)</th> </tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> </table>		Received By	(Date / Time)								
Relinquished By	(Date / Time)																												
Received By	(Date / Time)																												
INORGANIC SAMPLE No.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNAROUND	TAG No/ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME		ORGANIC SAMPLE No.	QC Type																				
MC0075	Industrial Process Wastewater/ BOBBY SAMPLER	H/C	Al (21), Ba (21), Ca (21), Cr (21), TM/CN (21)	6481, 6482, 6483, 6484, 6485 (5)	LOCATION ONE	S: 2/20/2001 16:02 E: 2/23/2001 16:02		C0075	--																				
MC0076	Ground Water/ JOE SAMPLER	L/C	Al (21), Ba (21), Ca (21), Cr (21), TM/CN (21)	6489, 6490, 6491, 6492, 6493 (5)	LOCATION TWO	S: 2/20/2001 16:01 E: 2/21/2001 16:01		C0076	Spike																				
MC0077	Industrial Effluent Wastewater/ JOE SAMPLER	M/G	Al (21), Ba (21), Ca (21), Cr (21), TM/CN (21)	6497, 6498, 6499, 6500, 6501 (5)	LOCATION ONE	S: 2/16/2001 15:55 E: 2/20/2001 15:55		C0077	--																				

Shipment for Case Complete? N	Sample(s) to be used for laboratory QC:	Additional Sampler Signature(s):	Chain of Custody Seal Number:
Analysis Key:	Concentration: L = Low, M = Low/Medium, H = High	Type/Designate: Composite = C, Grab = G	Shipment Iced? _____
Al = Aluminum, Ba = Barium, Ca = Calcium, Cr = Chromium, TM/CN = CLP TAL Total Metals and Cyanide			

TR Number: 3-103823254-022001-0003

PR provides preliminary results. Requests for preliminary results will increase analytical costs.
 Send Copy to: Sample Management Office, Attn: Heather Bauer, CSC, 15000 Conference Center Dr., Chantilly, VA 20151-3819; Phone 703/818-4200; Fax 703/818-4602

REGION COPY

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Figure 3-5. Inorganic Traffic Report & Chain of Custody Record (Region Copy)

3.2.3 Complete and Attach Custody Seals

Custody seals are usually pre-printed stickers that are signed (or initialed) and dated by the sampler after sample collection and placed on sample bottles or containers and/or shipping coolers or containers (see Figure 3-6). The custody seals document who sealed the sample container and verifies that the sample has not been tampered with. The seals must be placed such that they will break if the sample bottle or container or the shipping cooler or container is tampered with or opened after leaving custody of samplers. Custody seals can also be used to maintain custody of other items such as envelopes containing videotapes of the sample collection process.



Custody seals should never be placed directly onto a coring tool used as a transport device (e.g., 5 g Sampler) or tared, 40 mL closed-system vials. The seals must be placed on the bag for the coring tool used as a transport device, or on the bag used to enclose the vials. Refer to Appendix B for details.


 UNITED STATES ENVIRONMENTAL PROTECTION AGENCY OFFICIAL SAMPLE SEAL	SAMPLE NO.	DATE	SEAL BROKEN BY	DATE
	SIGNATURE			
	PRINT NAME AND TITLE			

Figure 3-6. Custody Seal

Instructions for completing and attaching a custody seal are included in Table 3-5.

Table 3-5. Completing and Attaching a Custody Seal

Step	Action	Important Notes
1	Record the CLP Sample Number.	The space for the CLP Sample Number does not need to be completed on custody seals being placed on the opening of a cooler, only on those being placed on the opening of sample bottles or containers.
2	Record the month, day, and year of sample collection.	
3	Sign the seal in the Signature field.	
4	Print your name and title in the Print Name and Title field.	
5	Place the custody seal over the edge of the sample bottle or container such that it will break if tampered with.	Custody seals can be placed directly on any sample container except for coring tools used as a transport device (e.g., 5 g Samplers) and tared VOA bottles. If packing coring tools used as a transport device or tared VOA bottles, place them in a clear plastic bag and place the custody seal on the outside of the bag.
6	If possible, cover the custody seal with clear plastic tape to protect it.	Take special care to not place the protective tape over the seal in such a way that it can be removed and then re-attached without signs of tampering.

The use and type of custody seals can vary by Region or collecting organization. Samplers should obtain the appropriate custody seals and specific instructions for correctly attaching them from the RSCC.

3.2.4 Complete and Attach Sample Labels

Samplers affix sample labels to each sample container. A sample label must contain the associated CLP Sample Number (either written or pre-printed), SMO-assigned Case Number, and the preservative used. It must also denote the analysis/fraction. Samplers may also include additional information such as the station location or the date/time of collection. Samplers should use FORMS II Lite to create and print sample labels. The sampler can print two labels and attach one to the sample container or bottle, and place the other label on the sample tag that should also be attached to the sample container or bottle. The

labels should then be covered with clear packaging tape to protect the label and maintain legibility. If handwriting a sample label, the sampler should complete the label information using waterproof ink, place the label on the outside of the sample bottle or container, then cover the label with clear packaging tape to protect the label and maintain legibility (see Figure 3-1).



Do not attach labels to tared VOA sample vials. A label should already be pre-attached to the tared vial.

3.2.5 Complete and Attach Sample Tags

To support use of sample data in potential enforcement actions, sample characteristics other than on-site measurements (e.g., pH, temperature, conductivity) can be identified with a sample tag. Typically, site-specific information is written on the tags using waterproof ink. The use and type of sample tags may vary by Region. For each sampling event, samplers should receive the required sample tags and type of information to include from the RSCC. The sampler can use FORMS II Lite to create and print out multiple sample labels, one of which can be attached to the sample tag and then covered with clear packaging tape to protect the label and maintain legibility. If FORMS II Lite-created sample labels are not available, a detailed set of instructions for completing and attaching a handwritten sample tag are included in Table 3-6.



The use and type of sample tags may vary among Regions.

Table 3-6. Completing and Attaching a Handwritten Sample Tag

Step	Action	Important Notes
1	Under the “Remarks” heading, record the CLP Sample Number and SMO-assigned Case Number.	Make sure to record the correct CLP Sample Number and SMO-assigned Case Number in a legible manner.
2	Record the project code (e.g., Contract Number, Work Assignment Number, Interagency Agreement Number, etc.) assigned by USEPA.	
3	Enter the station number assigned by the sampling team coordinator.	
4	Record the month, day, and year of sample collection.	
5	Enter the military time of sample collection (e.g., 13:01 for 1:01 PM).	
6	Identify the designate and place an “X” in either the “Comp.” or “Grab” box if the sample is either a composite or grab sample.	
7	Record the station location.	
8	Sign the sample tag in the Signature area.	
9	Place an “X” in the box next to Yes or No to indicate if a preservative was added to the sample.	
10	Under “Analyses”, place an “X” in the box next to the parameters for which the sample is to be analyzed.	
11	Leave the box for “Laboratory Sample Number” blank.	
12	It is recommended that the sample tag be attached to the neck of the sample bottle or container using regular string, stretch string, or wire (see Figure 3-1).	Do NOT use wire to attach a sample tag to a metals sample.


An example of a completed sample tag is included in Figure 3-7 below:

Project Code 2 00-030		Station No. 3 1		Mo./Day/Year 4 01/10/2004		Time 5 8:45 AM		Designate: 6				
						Comp.		Grab x				
3-3001 Tag No.	Station Location 7				Sampler's (Signature) 8 <i>John Smith</i>							
	DD001 Lab. Sample No.	Remarks: 1	SVOA organics	Pesticides	VOA organics x	ABN	Cyanide	Metals	Phenolics	COD, TOC, Nutrients	BOD Anions Solids (TSS) (TDS) (SS)	ANALYSES 10

Figure 3-7. Completed Sample Tag

3.3 Provide Sample Receipt

After samples have been taken from private property, the sampler should prepare a receipt for these samples and provide this receipt to the property owner. This is especially important when sampling on private property since these samples could be used during future litigation and the receipt will verify that the owner granted approval for the removal of the samples from the property. An example of a sample receipt created using FORMS II Lite is shown in Figure 3-8.

 EPA Region 3 U.S. ENVIRONMENTAL PROTECTION AGENCY		RECEIPT FOR SAMPLES					
PROJECT NO. QW-123		PROJECT NAME					
NAME & LOCATION OF FACILITY/SITE EXAMPLE SITE		SAMPLERS: (SIGNATURES)					
STATION NO.	LOCATION/DESCRIPTION	DATE	TIME	Comp/Grab	NO. OF EPA CONTAINERS	SPLIT SAMPLE Y OR N	EPA SAMPLE TAG NO.'S
STATION ONE	LOCATION ONE	2/20/2001	15:55	G	11	Yes	112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122
STATION ONE	LOCATION TWO	2/20/2001	16:01	C	11	Yes	123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133
STATION TWO	LOCATION ONE	2/20/2001	16:02	C	11	Yes	134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144
SPLIT SAMPLES TRANSFERRED BY: (PRINT)		DATE	SPLIT SAMPLES RECEIVED BY <input type="checkbox"/> OR DECLINED BY <input type="checkbox"/> (PRINT)		DATE/TIME		
(SIGN)		TIME	(SIGN)		TELEPHONE		
			TITLE				

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Figure 3-8. Sample Receipt Created Using the FORMS II Lite Software

3.4 Pack and Ship Samples

Once the samples have been collected, it is very important that the sampler properly package the samples for shipment and ensure that the samples are sent to the appropriate laboratory as quickly as possible. Prompt and proper packaging of samples will:

- Protect the integrity of samples from changes in composition or concentration caused by bacterial growth or degradation from increased temperatures;
- Reduce the chance of leaking or breaking of sample containers that would result in loss of sample volume, loss of sample integrity, and exposure of personnel to toxic substances; and
- Help ensure compliance with shipping regulations.

3.4.1 Sample Containers

Once samples are collected, they must be stored in conditions that maintain sample integrity. All samples should be placed in shipping containers or other suitable containers with ice to reduce the temperature as soon as possible after collection. Ideally, all samples should be shipped the day of collection for overnight delivery to the laboratory. If samples cannot be shipped on the day of collection, the sample temperature should be maintained at 4°C ($\pm 2^\circ\text{C}$) until they are shipped to the laboratory.

One CLP RAS sample may be contained in several bottles and vials. For example, one soil sample may consist of all containers needed for three of the analytical fractions available under this service (i.e., SVOA fraction, Pesticide fraction, and Aroclor fraction), even though the fractions are collected in separate containers. Therefore, the analysis to be performed and the matrix type will determine the type of container(s) that will be used, as well as the volume that must be collected for that particular sample fraction.

3.4.2 Inventory of Samples and Documentation

Prior to shipment, samplers should conduct an inventory of the contents of the shipping cooler or container against the corresponding TR/COC Record when packing for shipment to laboratories. An inventory will ensure that the proper number of containers have been collected for each analysis of the samples, that the required PE and QC samples and cooler temperature blanks are included, and the correct Sample Numbers and fractions have been assigned to each sample.

3.4.3 Shipping Regulations

Sample shipping personnel are legally responsible for ensuring that the sample shipment will comply with all applicable shipping regulations. For example, hazardous material samples must be packaged, labeled, and shipped in compliance with all IATA Dangerous Goods regulations or DOT regulations and USEPA guidelines. Refer to Appendix B for detailed shipping guidelines when using SW-846 Method 5035A to preserve and ship samples.

3.4.4 Sample Packaging for Shipment

Samplers are responsible for the proper packaging of samples for shipment. To ensure that samples are appropriately packaged (e.g., to avoid breakage and/or contamination) the sampler should consult their respective project plans to determine the proper packing and shipping procedures. The sampler must determine the sample type, pack the shipping containers correctly, include necessary paperwork, label and seal shipping containers or coolers, and ship the samples.

3.4.4.1 Determine the Sample Type and Container

Samplers should know what kinds of samples they are handling to ensure proper packaging. Samplers should refer to their appropriate project plans to determine which type of sample container should be used for each type of sample being taken during the sampling event.



Please follow Regional guidance with reference to samples containing dioxin or radioactive waste.

3.4.4.2 Pack Shipping Containers

It is imperative that samples are correctly and carefully packed in shipping containers to prevent the sample containers from breaking or leaking. Samplers must prepare and pack a shipping cooler or container according to the instructions outlined in Table 3-7.

Table 3-7. Packing Samples for Shipment

Step	Action	Important Notes
1	Seal all drain holes in the shipping container, both inside and out, to prevent leakage in the event of sample breakage.	
2	Check all lids/caps to make sure the samples are tightly sealed and will not leak.	
3	Seal samples within a clear plastic bag.	Custody seals can be placed directly on any sample container except for coring tools used as a transport device (e.g., 5 g Samplers) and tared VOA bottles. If packing coring tools used as a transport device or tared VOA bottles, place them in a clear plastic bag and place the custody seal on the outside of the bag.
4	Fully chill samples to 4°C (±2°C) prior to placement within suitable packing materials.	
5	Prior to placing samples within the shipping cooler, it is recommended that samplers line shipping containers with non-combustible, absorbent packing material.	
6	Place samples in CLEAN, sealed, watertight shipping containers (metal or hard plastic coolers).	
7	Conduct an inventory of the contents of the shipping cooler/container against the corresponding TR/COC Record.	
8	Cover samples in double-bagged ice to prevent water damage to packing materials.	Do NOT pour loose ice directly into the sample cooler. The ice is used to maintain the temperature of the samples within the shipping cooler.
9	It is recommended a temperature blank be included within each cooler being shipped.	The temperature blank is generally a 40 L vial filled with water and labeled “temperature blank” but does not have a Sample Number.
10	Ensure that the site name or other site-identifying information does not appear on any documentation being sent to the laboratory.	The laboratory should not receive any site-identifying information.

3.4.4.3 Include Necessary Paperwork

Samplers must properly place the necessary paperwork in the shipping cooler. All paperwork must be placed in a plastic bag or pouch and then secured to the underside of the shipping cooler lids (see Figure 3-9).

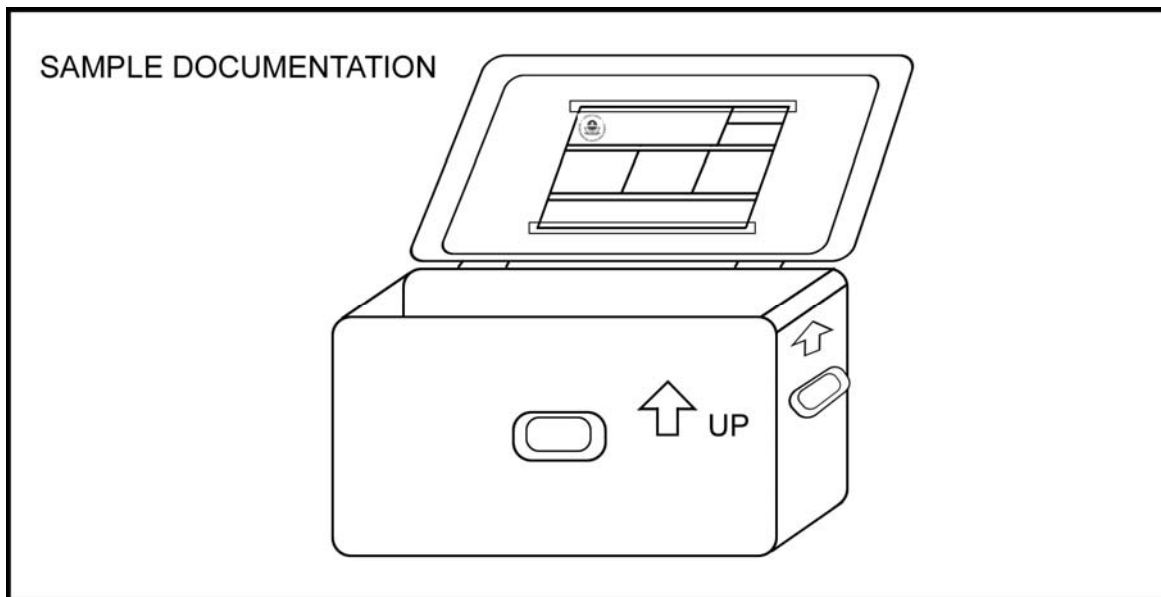


Figure 3-9. Sample Cooler with Attached TR/COC Record and Cooler Return Documentation

Necessary paperwork includes TR/COC Records and sample weight logs (see Figure 3-10), if required (for VOA samples). Samplers should contact their RSCC (or designee) for specific paperwork requirements.

USEPA Contract Laboratory Program Sample Weight Log									
Shipped to: AAA Testing Laboratory 1700 Mill Avenue Houston TX 77099 (281) 983-1234						Case No. 39563			
						DAS No. DAS34			
						Date Shipped: 9/29/2003			
Sample No.	Matrix	Analysis	Preservative	Bottle/ Tag Number	Tared Weight (g)	Final Weight (g)	Sample Weight (g)	Laboratory Weight	Traffic Report No.
C0036	Subsurface Soil (>12")	CLP TCL Volatiles	Ice Only	199548	32.80	37.20	4.40		3-103018225-092903-0001
C0036	Subsurface Soil (>12")	CLP TCL Volatiles	Ice Only	199547	32.10	38.30	6.20		3-103018225-092903-0001
C0036	Subsurface Soil (>12")	CLP TCL Volatiles	Ice Only	199549	31.20	38.60	7.40		3-103018225-092903-0001
C0037	Surface Soil (0"-12")	CLP TCL Volatiles	Ice Only	199552	32.00	36.90	4.90		3-103018225-092903-0001
C0037	Surface Soil (0"-12")	CLP TCL Volatiles	Ice Only	199551	32.40	37.10	4.70		3-103018225-092903-0001
C0037	Surface Soil (0"-12")	CLP TCL Volatiles	Ice Only	199550	31.90	35.90	4.00		3-103018225-092903-0001
Completed By:					Date:				
All weights are measured in grams									

Figure 3-10. Sample Weight Log

3.4.4.4 Return Sample Shipping Coolers

CLP laboratories must routinely return sample shipping coolers within 14 calendar days following shipment receipt. Therefore, the sampler should also include cooler return instructions with each shipment. The sampler (not the CLP laboratory) is responsible for paying for return of the cooler and should also include shipping airbills bearing the sampler's account number, as well as a return address to allow for cooler return.

3.4.4.5 Label and Seal Sample Shipping Coolers

After samples are packaged within shipping coolers, samplers must carefully secure the top and bottom of the coolers with tape, place return address labels clearly on the outside of the cooler, and attach the required chain-of-custody seals (see Figure 3-11).

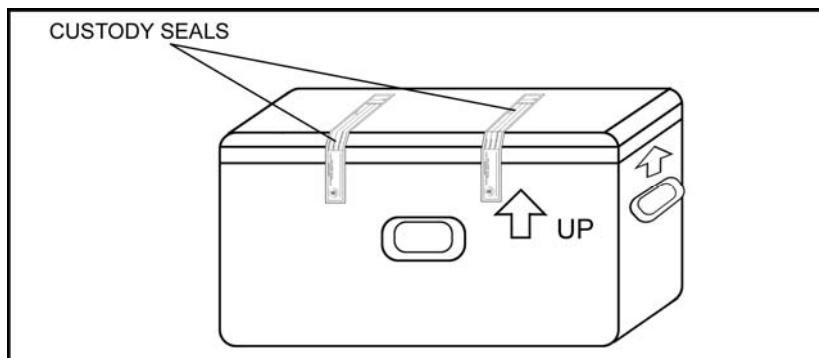


Figure 3-11. Shipping Cooler with Custody Seals

If more than one cooler is being delivered to a laboratory, samplers should mark each cooler as “1 of 2”, “2 of 2”, etc. In addition, samplers must accurately complete and attach shipping airbill paperwork for shipment of the samples to the laboratory. An airbill, addressed to the Sample Custodian of the receiving laboratory, should be completed for each cooler shipped. Samplers should receive the correct name, address, and telephone number of the laboratory to which they must ship samples from the RSCC or SMO. To avoid delays in analytical testing, samplers should make sure they are sending the correct types of samples to the correct laboratory when collecting samples for multiple types of analysis. For example, inorganic samples may be shipped to one laboratory for analysis, while organic samples may need to be shipped to another laboratory.

3.4.4.6 Ship Samples

The sampling contractor should ensure that samplers know the shipping company's name, address, and telephone number. In addition, they should be aware of the shipping company's hours of operation, shipping schedule, and pick-up/drop-off requirements.

Overnight Delivery

It is imperative that samples be sent via overnight delivery. Delays caused by longer shipment times may cause technical holding times to expire, which in turn may destroy sample integrity or require the recollection of samples for analysis.

Saturday Delivery

For shipping samples for Saturday delivery, the sampler **MUST** contact the RSCC (or their designee) or SMO so that SMO will receive the delivery information by 3:00 PM ET on the Friday prior to delivery.

3.4.5 Shipment Notification

When samples are shipped to CLP Laboratories, samplers **must immediately** report all sample shipments to the RSCC (or their designee) or to SMO. **Under no circumstances should the sampler contact the laboratory directly.** If samplers are shipping samples after 5:00 PM ET, they must notify the RSCC (or

designee) or SMO by 8:00 AM ET on the following business day. Samplers should receive the name and phone number of the appropriate SMO coordinator to contact from the Region/RSCC.

Samplers must provide the following information to the RSCC (or their designee) or to SMO:

- Name and phone number at which they can easily be reached (preferably closest on-site phone number if still in the field);
- SMO-assigned Case Number (see Section 2.4.1);
- Number, concentration, matrix and analysis of samples being shipped;
- Name of laboratory (or laboratories) to which the samples were shipped;
- Airbill number(s);
- Date of shipment;
- Case status (i.e., whether or not the Case is complete);
- Problems encountered, special comments, or any unanticipated issues;
- When to expect the next anticipated shipment; and
- An electronic export of the TR/COC Record (must be sent as soon as possible after sample shipment). For information regarding electronic export of TR/COC Records, refer to the following Web site:

<http://www.epa.gov/superfund/programs/clp/f2lsubmit.htm>



For Saturday delivery, samplers MUST contact the RSCC (or their designee) or SMO so that SMO will receive the delivery information by 3:00 PM ET on the Friday prior to delivery.

Samplers should be aware if their Region requires them to notify the RSCC (or designee) and/or SMO of sample shipment.

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Appendix A: Functions within a Sampling Project

The following table describes Quality Assurance Project Plan (QAPP) requirements taken from *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5).

Functions Within a Sampling Project	Elements of that Function
<i>Project Management</i>	
Project/Task Organization	Identifies the individuals or organizations participating in the project and defines their specific roles and responsibilities.
Problem Definition/Background	States the specific problem to be solved or decision to be made and includes sufficient background information to provide a historical and scientific perspective for each particular project.
Project/Task Description	Describes the work to be performed and the schedule for implementation to include: <ul style="list-style-type: none"> • Measurements to be made during the course of the project; • Applicable technical, regulatory, or program-specific quality standards, criteria, or objectives; • Any special personnel and equipment requirements; assessment tools needed; and • A work schedule and any required project and quality records, including types of reports needed.
Quality Objectives and Criteria	Describes the project quality objectives and measurement performance criteria.
Special Training/Certification	Ensures that any specialized training for non-routine field sampling techniques, field analyses, laboratory analyses, or data validation should be specified.
Documents and Records	<ul style="list-style-type: none"> • Itemizes the information and records that must be included in the data report package and specifies the desired reporting format for hard copy and electronic forms, when used. • Identifies any other records and/or documents applicable to the project such as audit reports, interim progress reports, and final reports that will be produced. • Specifies or references all applicable requirements for the final disposition of records and documents, including location and length of retention period.
<i>Data Generation and Acquisition</i>	
Sampling Process Design (Experimental Design)	<ul style="list-style-type: none"> • Describes the experimental design or data collection design for the project. • Classifies all measurements as critical or non-critical.
Sampling Methods	<ul style="list-style-type: none"> • Describes the procedures for collecting samples and identifies sampling methods and equipment. Includes any implementation requirements, support facilities, sample preservation requirements, and materials needed. • Describes the process for preparing and decontaminating sampling equipment to include the disposal of decontamination by-products, selection and preparation of sample containers, sample volumes, preservation methods, and maximum holding times for sampling, preparation, and/or analysis. • Describes specific performance requirements for the method. • Addresses what to do when a failure in sampling occurs, who is responsible for corrective action, and how the effectiveness of the corrective action shall be determined and documented
Sample Handling and Custody	<ul style="list-style-type: none"> • Describes the requirements and provisions for sample handling and custody in the field, laboratory, and transport, taking into account the nature of the samples, the maximum allowable sample holding times before extraction and analysis, and the available shipping options and schedules. • Includes examples of sample labels, custody forms, and sample custody logs.

Analytical Methods	<ul style="list-style-type: none"> Identifies the analytical methods and equipment required, including sub-sampling or extraction methods, waste disposal requirements (if any), and specific method performance requirements. Identifies analytical methods by number, date, and regulatory citation (as appropriate). If a method allows the user to select from various options, the method citations should state exactly which options are being selected. Addresses what to do when a failure in the analytical system occurs, who is responsible for corrective action, and how the effectiveness of the corrective action shall be determined and documented. Specifies the laboratory turnaround time needed, if important to the project schedule. Specifies whether a field sampling and/or laboratory analysis Case Narrative is required to provide a complete description of any difficulties encountered during sampling or analysis.
Quality Control (QC)	<ul style="list-style-type: none"> Identifies required measurement QC checks for both the field and laboratory. States the frequency of analysis for each type of QC check, and the spike compounds sources and levels. States or references the required control limits for each QC check and corrective action required when control limits are exceeded and how the effectiveness of the corrective action shall be determined and documented. Describes or references the procedures to be used to calculate each of the QC statistics.
Instrument/Equipment Testing, Inspection, and Maintenance	<ul style="list-style-type: none"> Describes how inspections and acceptance testing of environmental sampling and measurement systems and their components will be performed and documented. Identifies and discusses the procedure by which final acceptance will be performed by independent personnel. Describes how deficiencies are to be resolved and when re-inspection will be performed. Describes or references how periodic preventative and corrective maintenance of measurement or test equipment shall be performed. Identifies the equipment and/or system requiring periodic maintenance. Discusses how the availability of spare parts identified in the operating guidance and/or design specifications of the systems will be assured and maintained.
Instrument/Equipment Calibration and Frequency	<ul style="list-style-type: none"> Identifies all tools, gauges, instruments, and other sampling, measuring, and test equipment used for data collection activities affecting quality that must be controlled, and at specific times, calibrated to maintain performance within specified limits. Identifies the certified equipment and/or standards used for calibration. Describes or references how calibration will be conducted using certified equipment and/or standards with known valid relationships to nationally recognized performance standards. If no such standards exist, documents the basis for calibration. Indicates how records of calibration shall be maintained and traced to the instrument.
Inspection/Acceptance of Supplies and Consumables	<ul style="list-style-type: none"> Describes how and by whom supplies and consumables shall be inspected and accepted for use in the project. States acceptance criteria for such supplies and consumables.
Non-direct Measurements	<ul style="list-style-type: none"> Identifies any types of data needed for project implementation or decision-making that are obtained from non-measurement sources (e.g., computer databases, programs, literature files, historical databases). Describes the intended use of data. Defines the acceptance criteria for the use of such data in the project. Specifies any limitations on the use of the data.
Data Management	<ul style="list-style-type: none"> Describes the project data management scheme, tracing the data path from generation in the field or laboratory to their final use or storage. Describes or references the standard record-keeping procedures, document control system, and the approach used for data storage and retrieval on electronic media.

Appendix B: CLP Sample Collection Guidelines for VOAs in Soil by SW-846 Method 5035A

A. Preferred Options for the Contract Laboratory Program (CLP) are Options 1, 2, and 3:



Soil samples must be placed on their sides prior to being frozen.

Option 1.

Closed-system Vials:

Container - tared or preweighed 40 mL VOA Vials containing a magnetic stir bar.

Collect 5 g of soil per vial (iced or frozen in the field).

Regular Samples	3 Vials - Dry (5 g soil per vial) <u>1 Vial - Dry (filled with soil, no headspace)</u> 4 Total Vials
Regular Samples Requiring QC Analysis	9 Vials - Dry (5 g soil per vial) <u>1 Vial - Dry (filled with soil, no headspace)</u> 10 Total Vials

Option 2.

Closed-system Vials Containing Water:

Container - tared or pre-weighed 40 mL VOA vials containing a magnetic stir bar and 5 mL water.

Collect 5 g of soil per vial (iced or frozen in the field).

Regular Samples	2 Vials with water added (5 g soil and 5 mL water per vial) 1 Vial - Dry (5 g soil in vial) <u>1 Vial - Dry (filled with soil, no headspace)</u> 4 Total Vials (2 with water and 2 dry)
Regular Samples Requiring QC Analysis	6 Vials with water added (5 g soil and 5 mL water per vial) 5 Vials - Dry (5 g soil per vial) <u>1 Vial - Dry (filled with soil, no headspace)</u> 12 Total Vials (6 with water and 6 dry)

Option 3.

Coring Tool used as a Transport Device

Container - 5 g Samplers or equivalent.



All Samplers should be iced or frozen in the field and bagged individually.

Regular Samples	3 Samplers (5 g soil per Sampler) <u>1 Vial - Dry (filled with soil, no headspace)</u> 4 Total (3 Samplers and 1 Vial)
Regular Samples Requiring QC Analysis	9 Samplers (5 g soil per Sampler) <u>1 Vial - Dry (filled with soil, no headspace)</u> 10 Total (11 Samplers and 1 Vial)

B. Options 4, 5, and 6 are NOT preferred options for the CLP:

Option 4.

Closed-system Vials:

Container - tared or preweighed 40 mL VOA Vials containing a magnetic stir bar and preservative.

Collect 5 g of soil per vial and add Sodium bisulfate (NaHSO_4) preservative (5 mL water + 1 g NaHSO_4) - iced or frozen in the field.

Caution: This option is NOT a Preferred Option for the CLP because:

NaHSO_4 preservation creates low pH conditions that will cause the destruction of certain CLP target analytes (e.g., vinyl chloride, trichloroethene, trichlorofluoromethane, cis- and trans-1,3-dichloropropene). Projects requiring the quantitation of these analytes should consider alternative sample preservation methods. NaHSO_4 also cannot be used on carbonaceous soils. Check the soil before using this method of collection! Soil can be checked by placing a test sample in a clean vial, then adding several drops of NaHSO_4 solution. If the soil bubbles, use Option 4b and note this issue on the TR/COC Record.

Option 4a. Samples preserved in the field

Regular Samples	2 Vials with NaHSO_4 preservative added (5g soil per vial)
	1 Vial without NaHSO_4 preservative added (5g soil per vial)
	<u>1 Vial - Dry (filled with soil, no headspace)</u>
	4 Total Vials (2 with NaHSO_4 preservative and 2 without)
Regular Samples Requiring QC Analyses	4 Vials with NaHSO_4 preservative added (5g soil per vial)
	5 Vials without NaHSO_4 preservative added (5 g soil per vial)
	<u>1 Vial - Dry (filled with soil, no headspace)</u>
	10 Total Vials (4 with NaHSO_4 and 6 without)

Option 4b. Samples are preserved by the laboratory (No NaHSO_4 preservative is added to these samples in the field).

Regular Samples	3 Vials - Dry (5 g soil per vial)
	<u>1 Vial - Dry (filled with soil, no headspace)</u>
	4 Total Vials
Regular Samples Requiring QC Analyses	9 Vials - Dry (5 g soil per vial)
	<u>1 Vial - Dry (filled with soil, no headspace)</u>
	10 Total Vials

Option 5.

Methanol Preservation (medium-level analysis only):

Container - tared or pre-weighed 40 mL VOA vials containing 5-10 mL methanol.

Collect 5 g of soil per vial (iced in the field).

Caution: This is NOT a preferred option for the CLP because:

Samples preserved with methanol can only be analyzed by the medium-level method. Low-level Contract Required Quantitation Limit (CRQLs) cannot be achieved when samples are preserved this way.

Additional problems associated with use of methanol as a preservative in the field include:

- Possible contamination of the methanol by sampling-related activities (e.g., absorption of diesel fumes from sampling equipment);
- Leakage of methanol from the sample vials during shipping, resulting in loss of VOAs prior to analysis.

Regular Samples	2 Vials (5 g soil and 5-10 mL methanol per vial) <u>1 Vial - Dry (filled with soil, no headspace)</u> 3 Total Vials (2 with methanol and 1 dry)
Regular Samples Requiring QC Analysis	6 Vials (5 g soil and 5-10 mL methanol per vial) <u>1 Vial - Dry (filled with soil, no headspace)</u> 7 Total Vials (6 with methanol and 1 dry)



If shipping samples containing methanol as a preservative, a shipping label must be used to indicate methanol. This label must also contain the United Nations (UN) identification number for methanol (UN 1230), and indicate Limited Quantity.

Option 6.**Glass Containers filled with sample - No Headspace:****Container - 4 oz Glass Jars.**

Glass container filled with soil with no headspace and iced.

Caution: This is NOT a preferred option for the CLP because:

Samples collected in this manner lose most of their volatile analytes prior to analysis when the sample containers are opened and sub-sampled in the laboratory. This option is only available due to Regional requirements.

Regular Samples	2 Glass Jars (4 oz) filled with sample, no headspace <u>1 Vial - Dry (filled with soil, no headspace)</u> 3 Total Containers
Regular Samples Requiring QC Analysis	2 Glass Jars (4 oz) filled with sample, no headspace <u>1 Vial - Dry (filled with soil, no headspace)</u> 3 Total Containers

C. Caution:

1. Extreme care must be taken to ensure that frozen samples do not break during shipment.
2. Before adding soil to pre-weighed vials containing a stir bar, weigh the vials to confirm the tared weight. If the weight varies by more than 0.1 g, record the new weight on the label and the sample documentation. Do NOT add labels to these vials once the tared weight has been determined/confirmed.

D. Dry Samples:

All options include taking a sample in a dry 40 mL VOA vial (or a 4 oz wide mouth jar) with no headspace. No additional water, NaHSO₄, or methanol is added to this sample. This sample is taken to determine moisture content; therefore, it does not need to be tared or have a stir bar.

E. Iced or Frozen Samples:

1. Iced means cooled to 4°C (±2°C) immediately after collection.
2. Frozen means cooled to between -7°C and -15°C immediately after collection.

F. Sample Delivery:

CLP strongly recommends that all samples reach the laboratory by COB the next day after sample collection.

G. Notes:

1. For Option 4, samples can be preserved with NaHSO₄ either:
 - In the field; or
 - In the laboratory upon receipt. In this case, the sampler should put the following information in the Preservation Column of the TR/COC Record - "To be preserved at lab with NaHSO₄". This Regional Request should also be communicated to SMO so that the laboratory can be notified.
2. Regional QAPPs may require the use of Option 5. Please note that this option is for medium-level analysis ONLY.
3. If water, methanol, or NaHSO₄ preservative is added to the vials in the field, a field blank containing the appropriate liquid used in the vials should be sent to the laboratory for analysis.

H. Number of Containers Rationale:

The rationale for the number of containers (vials or samplers) required for the field sample and the required laboratory QC for each option is given as follows:

Option 1.

Rationale for Regular Vials:

- 1 vial for low-level analysis (water purge)
- 1 vial for backup low-level analysis
- 1 vial for medium-level analysis (methanol extraction)

Rationale for QC Vials:

- 2 vials for MS and MSD low-level analysis
- 2 vials for MS and MSD medium-level analysis
- 2 vials for backup (MS and MSD) low-level or medium-level analysis

Option 2.

Rationale for Regular Vials:	1 vial for low-level analysis (water purge) 1 vial for back up low-level analysis 1 vial dry for medium-level analysis (methanol extraction)
Rationale for QC Vials:	2 vials for MS and MSD low-level analysis 2 vials for MS and MSD medium-level analysis 2 vials for backup (MS and MSD) low-level or medium-level analysis
Medium-level: Analysis	Methanol will be added in the laboratory

Option 3.

Rationale for Regular Samples:	1 sampler for low-level analysis (water purge) 1 sampler for back up low-level analysis 1 sampler for medium-level analysis (methanol extraction)
Rationale for QC Samples:	2 samplers for MS and MSD low-level analysis 2 samplers for backup MS and MSD low-level analysis 2 samplers for MS and MSD medium-level analysis 2 samplers for backup MS and MSD medium-level analysis

Option 4a (NaHSO₄ added in the field).

Rationale for Regular Vials:	1 vial with water for low-level analysis (water purge) 1 vial with water for backup low-level analysis 1 vial dry for medium-level analysis (methanol extraction)
Rationale for QC Vials:	2 vials with water for MS and MSD low-level analysis 2 vials dry for MS and MSD medium-level analysis 2 vials for backup (MS and MSD) low-level or medium-level analysis

Option 4b (NaHSO₄ added in the laboratory).

Rationale for Regular Vials:	1 vial for low-level analysis (water purge) 1 vial for backup low-level analysis 1 vial for medium-level analysis (methanol extraction)
Rationale for QC Vials:	2 vials for MS and MSD low-level analysis 2 vials for MS and MSD medium-level analysis 2 vials for backup (MS and MSD) low-level or medium-level analysis

Option 5.

Rationale for Regular Samples:	1 vial for regular medium-level analysis 1 vial for back up medium-level analysis
Rationale for QC Samples:	2 samples for MS and MSD 2 samples for backup MS and MSD

Option 6.

In this option, all Regular and QC samples for both low-level and medium analysis are taken as subsamples from the same container.

Rationale for Regular Analysis	1 glass jar for low-level analysis and medium-level analysis 1 glass jar for backup low-level analysis and medium-level analysis
Rationale for QC Analysis:	1 glass jar for low-level analysis and medium-level analysis 1 glass jar for backup low-level analysis and medium-level analysis

Appendix C: General CLP Sample Collection Guidelines

VOAs in Water



Regional guidance and/or specific Project Plan requirements will supersede the guidelines listed below.

Collect the following:

- At least two 40 mL glass containers with polytetrafluoroethylene (PTFE)-lined septa and open top screw-caps that are filled to capacity with no air bubbles, preserved to a pH of 2 with HCl, and cooled to 4°C (±2°C) immediately after collection. **DO NOT FREEZE THE SAMPLES.**
- If Selected Ion Monitoring (SIM) analysis is requested, at least two additional 40 mL glass containers with PTFE-lined septa and open top screw-caps that are filled to capacity with no air bubbles, preserved to a pH of 2 with HCl, and cooled to 4°C (±2°C) immediately after collection.

Test for Carbonates, Residual Chlorine, Oxidants, and Sulfides:

- It is very important that samplers obtain Regional guidance when testing and ameliorating for:
 - Carbonates;
 - Residual chlorine (e.g., municipal waters or industrial waste waters that are treated with chlorine prior to use or discharge); or
 - Oxidants.
- VOA samples containing carbonates react with the acid preservative causing effervescence (due to formation of carbon dioxide), which can cause loss of volatile analytes.
- Residual chlorine present in VOA samples can continue to react with dissolved organic matter. This continuous reaction may lead to inaccurate quantitation of certain analytes present in the sample at the time of collection.
- Residual chlorine and oxidants present in VOA samples can cause degradation of certain volatile analytes (e.g., styrene).

Perform the following for *Pre-Preserved Vials*:

1. Pour the sample slowly down the edge of the sample vial to avoid excess aeration or agitation of the sample during filling.
2. Fill the vial completely so that a reverse (convex) meniscus is present and ensure that there are no air bubbles present (either in the body or especially at the top of the vial).
3. Place the septum on the vial so that the PTFE side is in contact with the sample, and then firmly tighten the cap.
4. Gently flip the vial a few times to ensure that the sample is mixed with the acid preservative.
5. While holding the vial upright, gently tap the sample to check for air bubbles (either in the body or especially at the top of the vial).
6. If air bubbles are present, discard the sample and select a new vial in which to recollect a new sample. Repeat Steps 1 - 5 above.
7. Do NOT mix or composite samples for VOAs.
8. Cool sample to a temperature of 4°C (±2°C). Samplers should begin the cooling process in the field as samples are being collected. Double-bagged ice should be used. **DO NOT FREEZE WATER SAMPLES.**
9. Immediately transfer the vial to the sample shuttle (device that contains a “set” of VOA vials) once it has been collected. Do **NOT** allow ice to touch the vials.

Perform the Following for *Empty Vials*:

1. Rinse the vial with sample water prior to actual sample collection and preservation.



Regions vary in their approach to pre-rinsing and/or re-using sample vials (e.g., some Regions do not recommend pre-rinsing and/or re-use of pre-cleaned containers using sample water). Be sure to follow Regional guidance.

2. Add 1-2 mL of acid preservative to the vial. Check to ensure that the sample you are collecting requires a preservative (follow Regional guidance).
3. Pour the sample slowly down the edge of the sample vial to avoid excess aeration and agitation of the sample.
4. Fill the vial completely so that a reverse (convex) meniscus is present and ensure that there are no air bubbles present (either in the body or especially at the top of the vial).
5. Place the septum on the vial so that the PTFE side is in contact with the sample, and then firmly tighten the cap.
6. Gently flip the vial a few times to ensure that the sample is mixed with the acid preservative.
7. While holding the vial upright, gently tap the vial to check for air bubbles (either in the body or especially at the top of the vial).
8. If air bubbles are present, discard the sample and recollect a new sample using the same sample vial. Repeat Steps 1 - 7 above.
9. Check the recollected sample for air bubbles. If air bubbles are present, additional sample water may be added to the vial to eliminate air bubbles. If there are air bubbles after three consecutive attempts to eliminate air bubbles by the addition of sample water, the entire sample and sample vial should be discarded and a new sample collected.
10. Do NOT mix or composite samples for VOAs.
11. Cool sample to a temperature of 4°C ($\pm 2^\circ\text{C}$). Samplers should begin the cooling process in the field as samples are being collected. Double-bagged ice should be used. DO NOT FREEZE WATER SAMPLES.
12. Immediately transfer the vial to the sample shuttle (device which contains a “set” of VOA vials) once it has been collected. Do NOT allow ice to touch the vials.

Things to Remember:

- Samples must be shipped as soon as possible, preferably on the same day as sample collection to avoid exceeding sample holding times. If overnight transit is not possible, samples should be maintained at 2 - 4°C until they are shipped to the laboratory.
- If samples are not preserved (a requirement for certain analytes), the technical holding time is shortened to 7 days.

Appendix D: Sampling Techniques and Considerations

During a sampling event, the sampler is expected to follow prescribed sampling techniques. The sampler should also be aware of any special sampling considerations, contaminant issues, and sample compositing and mixing methods that could affect their sampling efforts.



Regional guidance will take precedence over any of the techniques and considerations listed below.

D.1 General Sampling Techniques

Information regarding surface water, sediment, soil, and groundwater sampling can be found in many documents including, but not limited to, the following sources:

- Compendium of ERT Surface Water and Sediment Sampling Procedures, EPA/540/P-91/005;
- Compendium of ERT Soil Sampling and Surface Geophysics Procedures, EPA/540/P-91/006;
- Compendium of ERT Groundwater Sampling Procedures, EPA/540/P-91/007;
- Quality Assurance Sampling Plan for Environmental Response (QASPER) software, Version 4.1, ERT; and
- *Requirements for the Preparation of Sampling and Analysis Plans*; United States Army Corps of Engineers, February 1, 2001, EM 200-1-3.

When working with potentially hazardous materials, samplers should follow USEPA and OSHA requirements, specific health and safety procedures, and DOT requirements.

D.2 Special Sampling Considerations

Samplers should refer to Regionally-developed SOPs to obtain specific procedures for properly collecting and preserving samples in the field. For additional guidance regarding sampling for VOAs in soil and water, see Appendices B and C. Samplers should obtain Regional guidance when testing and ameliorating for:

- Carbonates in VOA soil and water;
- Residual chlorine in VOA soil and water, or cyanide water;
- Oxidants in VOA soil and water; or
- Sulfides in cyanide.

D.3 Contaminant Sampling

Certain compounds can be detected in the parts-per-billion (ppb) and/or parts-per-trillion (ppt) range. Extreme care MUST be taken to prevent cross-contamination of these samples. The following precautions should be taken when trace contaminants are a concern:

- Disposable gloves should be worn each time a different location is sampled.
- When collecting both surface water and sediments, surface water samples should be collected first. This reduces the chance of sediment dispersal into surface water, and the resulting loss of surface water sample integrity.
- Sampling should occur in a progression from the least to the most contaminated area, if this information is known to the sampling team.
- Samplers should use equipment constructed of PTFE, stainless steel, or glass that has been properly pre-cleaned for collection of samples for trace organic and/or inorganic analyses. Equipment constructed of plastic or polyvinyl chloride (PVC) should NOT be used to collect samples for trace organic compound analyses.
- Equipment constructed of stainless steel should NOT be used to collect samples for trace metals analysis.

D.4 Sample Compositing

Sample compositing is a site-specific activity that must be conducted according to the SAP. Compositing is typically used for large sites under investigation to improve the precision (i.e., lower the variance) of the estimated average contaminant concentrations. **Samples for VOA analysis should NOT be composited to minimize loss of VOAs/analytes.**

Composite samples consist of a series of discrete grab samples that are mixed together to characterize the average composition of a given material. The discrete samples are usually of equal volume, but may be weighted to reflect an increased flow or volume. Regardless, all discrete samples must be collected in an identical manner and the number of grab samples forming a composite should be consistent. There are several compositing techniques that may be required such as:

- Flow-proportioned – Collected proportional to the flow rate during the compositing period by either a time-varying/constant volume or a time-constant/varying volume method. This technique is usually associated with wastewater or storm water runoff sampling.
- Time – Composed of a varying number of discrete samples collected at equal time intervals during the compositing period. This technique is typically used to sample wastewater and streams, and in some air sampling applications.
- Areal – Collected from individual grab samples collected in an area or on a cross-sectional basis. Areal composites are comprised of equal volumes of grab samples where all grabs are collected in an identical manner. This technique is typically used for estimating average contaminant concentrations in soils or sediments. This technique is useful when contaminants are present in nugget form (i.e., TNT chunks, lead shot, etc.), thus exhibiting large differences in concentration over a small sample area.
- Vertical – Collected from individual grab samples but taken from a vertical cross section. Vertical composites are comprised of equal volumes of grab samples where all grab samples are collected in an identical manner. Examples would include vertical profiles of a soil borehole or sediment columns.
- Volume – Collected from discrete samples whose aliquot volumes are proportional to the volume of sampled material. Volume composites are usually associated with hazardous waste bulking operations where the sample represents combined or bulked waste.

When compositing solid samples (i.e., sediment, soil, or sludge) for analysis of compounds present in trace quantities, use a stainless steel or PTFE bowl and spatula.

D.5 Sample Mixing and Homogenizing

Mixing of the sample for the remaining parameters is necessary to create a representative sample media. It is extremely important that solid samples be mixed as thoroughly as possible to ensure that the sample is as representative as possible of the sample location. Please refer to the project-specific SAP regarding instructions on removal of any extraneous materials (e.g., leaves, sticks, rocks, etc.). The mixing technique will depend on the physical characteristics of the solid material (e.g., particle size, moisture content, etc.). The mixing container should be large enough to hold the sample volume and accommodate the procedures without spilling. Both the mixing container (generally a bowl or tray) and the mixing implement should be properly decontaminated before use. Samples should be homogenized according to procedures listed in the project-specific SAP.

Samples for VOA analysis should not be mixed to minimize loss of volatile analytes.


Table D-1 provides a short procedure for mixing a soil sample with a small particle size (less than 1/4 in) and filling sample containers in the field.

Table D-1. Mixing a Sample and Filling Sample Containers

Step	Action
1	Roll the contents of the compositing container to the middle of the container and mix.
2	Quarter the sample and move to the sides of the container.
3	Mix each quarter individually, then combine and mix OPPOSITE quarters, then roll to the middle of the container.
4	Mix the sample once more, and then quarter the sample again.
5	Mix each quarter individually, then combine and mix ADJACENT corners, then roll to the middle of the container. The goal is to achieve a consistent physical appearance before sample containers are filled.
6	Flatten piled material into an oblong shape.
7	Using a flat-bottomed scoop, collect a strip of soil across the entire width of the short axis and place it into a sample container.
8	Repeat Step 7 at evenly-spaced intervals until the sample containers are filled.
9	Record the approximate quantity of each subsample in the field log book.


Appendix E: Sampling Checklists

Appendix E-1: Personnel Preparation Checklist (Page 1 of 1)


Personnel Briefing	Yes	No	Comments:
1. Did you review sampling team responsibilities and identify individual(s) responsible for corrective actions?			
2. Did you ensure that you have met the appropriate personal safety and protection requirements?			
3. Did you identify sampling locations and receive permission to access them, as appropriate?			
4. Did you contact the appropriate utility companies PRIOR to the start of sampling?			
 <p>By law, utility companies must be contacted prior to the start of digging/sampling so that any underground utilities (gas lines, water lines, electrical lines, etc.) can be marked. A list of one-call centers for each state may be found at: http://www.digsafely.com/contacts.htm.</p>			
5. If sampling on private property, do you have sample receipts to provide to the property owner for all samples taken and removed from the property?			
6. Have you determined the number and type of samples to be collected?			
7. Did you review sample collection methods?			
8. Have you reviewed sample container requirements?			
9. Did you review decontamination requirements, procedures, and locations?			
10. Did you determine holding times and conditions?			
11. Did you determine Performance Evaluation (PE) and Quality Control (QC) sample requirements?			
12. Have you obtained shipping cooler temperature blanks, if required?			
13. Did you review sample label and tag requirements?			
14. Did you review Traffic Report/Chain of Custody (TR/COC) Record and custody seal requirements?			
15. Have you obtained the laboratory name, shipping addresses, and telephone number?			
16. Did you review cooler return instructions?			
17. Have you obtained shipping company information (name, telephone number, account number, pickup schedule)?			
18. Have you obtained shipping schedules?			
19. Did you review shipment reporting requirements and the appropriate contact names and telephone numbers for reporting?			
20. Have you included any sampler comments regarding sampling issues (e.g., low volumes, matrix, suspected concentrations based on field measurements)?			

Appendix E-2: General Sample Collection Checklist




(Page 1 of 1)

General Sample Collection	Yes	No	Comments:
1. Did you identify and mark the sampling location with buoys, flags, or stakes according to the sampling plans, maps, and grids?			
2. If the sampling location is inaccessible, did you contact the appropriate field or Regional personnel for instructions?			
3. Did you use the correct sampling equipment?			
4. Did you follow the correct decontamination procedures?			
5. Did you follow the correct collection procedures?			
6. Did you use the correct sample containers for each sample collected?			
7. Did you collect the correct volume for each sample?			
8. Did you collect the correct type of sample, including primary samples and Quality Control (QC) samples?			
9. Did you properly preserve each sample collected?			
10. Did you correctly document and label each sample with all necessary information?  Under no circumstances should the site name appear on any documentation being sent to the laboratory.			
11. If sampling on private property, did you provide a sample receipt to the owner of the property for all samples taken and removed from the property?			

Appendix E-3: Completing Field Logbook Checklist
(Page 1 of 1)


Completing Field Logbook		Yes	No	Comments:
1.	Did you use waterproof ink when writing in the field logbook?			
2.	Did you document sampling project information such as: <ul style="list-style-type: none"> • Project name, ID, and location; • Names of samplers; • Geological observations, including maps; • Atmospheric conditions; • Field measurements; and • Sampling dates, times, and locations?  Under no circumstances should the site name appear on any documentation being sent to the laboratory.			
3.	Did you record sampling activity information such as: <ul style="list-style-type: none"> • Sampling dates and times; • Sample identifications; • Sample matrices; • Sample descriptions (e.g., odors and/or colors); • Number of samples taken; • Sampling methods/equipment; and • Description of QC samples? 			
4.	Did you document any and all deviations from the sampling plan?			
5.	Did you document any and all difficulties in sampling and/or any unusual circumstances?			
6.	Were all errors corrected by crossing a line through the error, initialing the error, dating the error, and then adding the correct information?			

Appendix E-4: Completing Handwritten Sample Labels Checklist
(Page 1 of 1)

Completing Handwritten Sample Labels	Yes	No	Comments:
1. Did the Region provide CLP Sample Numbers and SMO-assigned Case Numbers?			
2. If additional CLP Sample Numbers were needed, did you contact the appropriate Regional personnel?			
3. Were the CLP Sample Numbers and SMO-assigned Case Numbers on the labels correct? Organic CLP Sample Numbers begin with the Regional letter code, followed by letters and numbers. Inorganic CLP Sample Numbers begin with "M", followed by the Regional letter code, and then letters and numbers.  The following characters are not used in generating CLP Sample Numbers and should never appear on any paperwork sent to the laboratory: I; O; U; and V. Also, the last character of a CLP Sample Number will never be a letter.			
4. Were samples uniquely numbered and designated to only one sample?  Samples collected for total metal and dissolved metal analyses must receive separate, unique, CLP Sample Numbers.			
5. Were Quality Control (QC) samples numbered accordingly?			
6. Were the specific requirements followed for total and dissolved metals analysis, QC and Performance Evaluation (PE) samples, and SW-846 Method 5035A?			
7. Were all temperature blanks labeled with "TEMPERATURE BLANK"?			
8. Was a sample label containing the CLP Sample Number, SMO-assigned Case Number, location, concentration, preservative, and the fraction/analysis, attached to each sample bottle or container as the sample was collected?  Under no circumstances should the site name appear on any documentation being sent to the laboratory.			
9. Was clear tape placed over the sample labels to protect the labels from moisture and to help the labels adhere to the sample bottle?			
10. Were all errors corrected by crossing a line through the error, initialing the error, dating the error, and then adding the correct information?			

Appendix E-5: Completing Handwritten Sample Tags & Custody Seals Checklists

(Page 1 of 1)



Completing Handwritten Sample Tags	Yes	No	Comments:
1. Was waterproof ink used on the sample tags?			
2. If Regionally required for individual sample containers, was the project code on the sample tag completed?			
3. Was the station number on the sample tag completed?			
4. Was the date filled in using the format MM/DD/YYYY?			
5. Was the time of sample collection indicated in military time format HH:MM?			
6. Was the box checked indicating composite or grab sample?			
7. Was the station location on the sample tag completed?			
8. Did you indicate whether or not the sample was preserved by checking "yes" or "no?"			
9. Was the appropriate analysis indicated on the sample tag?			
10. Were the appropriate CLP Sample Number and SMO-assigned Case Number indicated and cross-referenced with the numbers on the sample label?			
11. Did you sign the sample tags?			
<div style="display: flex; align-items: center;">  <div style="margin-left: 10px;">Do NOT use wire to attach a sample tag to a metal sample.</div> </div>			
13. Were all errors corrected by crossing a line through the error, initialing the error, dating the error, and then adding the correct information?			
Completing Custody Seals	Yes	No	Comments:
1. Did you sign and date the custody seal?			
2. Did you attach a completed custody seal to the sample bottle, container, or plastic bag, placing the seal over the cap or lid of each sample bottle or container or on the bag opening such that it will be broken if the sample bottle, container, or bag is opened or tampered with?			
3. As appropriate, did you attach the completed custody seal to the sample shipping container or cooler, placing the seal such that it will be broken if the container or cooler is opened or tampered with?			
4. Were all errors corrected by crossing a line through the error, initialing the error, dating the error, and then adding the correct information?			

Appendix E-6: Packing Sample Container Checklist (Page 1 of 1)

Packing Sample Container	Yes	No	Comments:
<p>1. Did you follow all State, Federal, Department of Transportation (DOT), and International Air Transportation Association (IATA) regulations governing the packaging of environmental and hazardous samples?</p> <div style="border: 1px solid black; padding: 2px; width: 40px; float: left; margin-right: 10px;"> Note </div> <p>If samples contain methanol preservation (e.g., samples to be analyzed by SW-846 Method 5035A), refer to the packaging instructions in Appendix A.</p>			
2. Were all CLP Sample Numbers, SMO-assigned Case Numbers, fractions/analyses, labels, tags, and custody seals attached to the correct sample containers?			
3. Was an inventory conducted of CLP Sample Numbers, SMO-assigned Case Numbers, fractions/analyses, and containers, and verified against the TR/COC Records?			
4. Were the correct number and type of Performance Evaluation (PE) and Quality Control (QC) samples collected?			
5. Were all sample containers sealed in clear plastic bags with the sample label and tag visible through the packaging?			
6. Were all soil/sediment samples known to contain dioxin securely enclosed in metal cans (e.g., paint cans) with the lids sealed?			
7. Was suitable absorbent packing material placed around the sample bottles or containers?			
8. Were the outsides of metal containers labeled properly with the CLP Sample Number, SMO-assigned Case Number, and the fraction/analysis of the sample inside?			

Appendix E-7: Packing Shipping Container Checklist

(Page 1 of 1)

Packing Shipping Container	Yes	No	Comments:
1. Were you shipping samples in a clean waterproof metal or hard plastic ice chest or cooler in good condition?			
2. Were all non-applicable labels from previous shipments removed from the container?			
3. Were all inside and outside drain plugs closed and covered with suitable tape (e.g., duct tape)?			
4. Was the inside of the cooler lined with plastic (e.g., large heavy-duty garbage bag)?			
5. Was the lined shipping cooler packed with noncombustible absorbent packing material?			
6. Were sample containers placed in the cooler in an upright position not touching one another?			
7. Was a sample shipping cooler temperature blank included in the cooler?			
8. Did the documentation in the cooler only address the samples in that cooler?			
9. Was the site name absent from all documentation?  Under no circumstances should the site name appear on any documentation being sent to the laboratory.			
10. Was there sufficient packing material around and in between the sample bottles and cans to avoid breakage during transport?			
11. If required, was double-bagged ice placed on top and around sample bottles to keep the samples cold at 4°C (± 2° C)?  Do Not Pack Loose Ice Into the Cooler!			
12. Was the top of the plastic liner fastened and secured with tape?			
13. Was a completed custody seal placed around the top of the fastened plastic liner (if required by the Region)?			
14. Were all sample documents enclosed within the cooler (e.g., TR/COC Record and cooler return instructions) in a waterproof plastic bag?			
15. Was the plastic bag, containing the documentation, taped to the underside of the cooler lid?			
16. Were cooler return instructions and airbills, if required, taped to the underside of the cooler lid?			
17. Was the return address of the cooler written with permanent ink on the underside of the cooler lid?			
18. Was tape placed around the outside of the entire cooler and over the hinges?			
19. Were the completed custody seals placed over the top edge of the cooler so the cooler cannot be opened without breaking the seals?			
20. Was the return address label attached to the top left corner of the cooler lid?			
21. Were instructional labels attached to the top of the cooler, as necessary (e.g., "This End Up," "Do Not Tamper With," or "Environmental Laboratory Samples")?			
22. If shipping hazardous samples, were the correct labels attached to the cooler (e.g., "Flammable Liquids", "Caution", or "Poison")?			
23. If shipping samples containing methanol as a preservative (e.g., samples to be analyzed by SW-846 Method 5035A), was a label used to indicate methanol, the United Nations (UN) identification number for methanol (UN 1230), and Limited Quantity?			

Appendix E-8: Shipping & Reporting CLP Samples Checklist
(Page 1 of 1)

Shipping CLP Samples		Yes	No	Comments:
1.	Did you follow all State, Federal, Department of Transportation (DOT), and International Air Transportation Association (IATA) regulations governing the shipment of environmental and hazardous samples?			
2.	Was a separate airbill filled out for each cooler being shipped?			
3.	Was the airbill filled out completely, including correct laboratory name, address, and telephone number, identification of recipient as "Sample Custodian," and appropriate delivery option (e.g., overnight or Saturday)?			
4.	Was the completed airbill attached to the top of the cooler with the correct laboratory address?			
5.	If more than one cooler was being shipped to the same laboratory, were they marked as "1 of 2," "2 of 2," etc.?			
6.	Were the samples being shipped "overnight" through a qualified commercial carrier?			
Reporting CLP Samples		Yes	No	Comments:
1.	Did you contact the Contract Laboratory Program Sample Management Office (SMO) on the same day samples were shipped?			
2.	If the samples were shipped after 5:00 PM Eastern Time (ET), were they reported to the RSCC (or designee) or to SMO by 8:00 AM ET the following business day?			
3.	Did you notify the RSCC (or designee) or SMO so that SMO will receive the delivery information by 3:00 PM ET on Friday for sample shipments that will be delivered to the laboratory on Saturday?			
4.	Did you provide the RSCC (or designee) or SMO with: <ul style="list-style-type: none"> Your name, phone number, and Region number; Case Number of the project; Exact number of samples, matrix(ces), concentration(s), and type of analysis; Laboratory(ies) to which the samples were shipped; Carrier name and airbill number; Date of shipment; Date of next shipment; and Any other information pertinent to the shipment? 			

Appendix F: Glossary

Analyte -- The element, compound, or ion that is determined in an analytical procedure; the substance or chemical constituent of interest.

Analytical Services Branch (ASB) -- Directs the Contract Laboratory Program (CLP) from within the United States Environmental Protection Agency's (USEPA's) Office of Superfund Remediation and Technology Innovation (OSRTI) in the Office of Solid Waste and Emergency Response (OSWER).

Aroclor -- Polychlorinated biphenyls (PCBs) or a class of organic compounds with 1 to 10 chlorine atoms attached to biphenyl and a general chemical formula of $C_{12}H_{10-x}Cl_x$. PCBs, commercially produced as complex mixtures containing multiple isomers at different degrees of chlorination, were marketed in North America under the trade name Aroclor.

Case -- A finite, usually predetermined, number of samples collected over a given time period from a particular site. Case Numbers are assigned by the Sample Management Office (SMO). A Case consists of one or more Sample Delivery Groups (SDGs).

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) -- Initiated in December 1980, CERCLA provided broad federal authority to respond directly to the release or possible release of hazardous substances that may endanger human health or the environment. CERCLA also established a trust fund to provide for cleanup when no responsible party could be identified; hence CERCLA is commonly referred to as "Superfund".

Contract Laboratory Program (CLP) -- A national program of commercial laboratories under contract to support the USEPA's nationwide efforts to clean up designated hazardous waste sites by providing a range of chemical analytical services to produce environmental data of known and documented quality. This program is directed by USEPA's Analytical Services Branch (ASB).

Contract Laboratory Program Project Officer (CLP PO) -- Monitors technical performance of the contract laboratories in each Region.

Contract Laboratory Program Sample Management Office (CLP SMO) -- A contractor-operated facility operated under the CLP, awarded and administered by the USEPA, which provides necessary management, operations, and administrative support to the CLP. SMO coordinates and schedules sample analyses, tracks sample shipments and analyses, receives and tracks data for completeness and compliance, and processes laboratory invoices.

Custody Seal -- An adhesive label or tape that is used to seal a sample bottle or container that maintains chain-of-custody and that will break if the sample bottle or container is opened or tampered with.

Cyanide (Total) -- Cyanide ion and complex cyanides converted to hydrocyanic acid (HCN) by reaction in a reflux system of a mineral acid in the presence of magnesium ion.

Data Quality Objective (DQO) -- The requirements established to maintain the quality of the data being collected.

Data Validation -- Data validation is based on Region-defined criteria and limits, professional judgment of the data validator, and (if available) the Quality Assurance Project Plan (QAPP) and Sampling and Analysis Plan (SAP).

Equipment Blank -- A sample used to check field decontamination procedures. See Field Blank.

Field Blank -- Any blank sample that is submitted from the field. Each field blank is assigned its own unique USEPA Sample Number. A Field Blank checks for cross-contamination during sample collection, sample shipment, and in the laboratory. A field blank includes trip blanks, rinsates, equipment blanks, etc.

Field Duplicate -- Checks reproducibility of laboratory and field procedures and indicates non-homogeneity.

Field Operations Reporting Management System (FORMS) II Lite -- A stand-alone, Windows-based software application that enables samplers to automatically create and generate sample documentation both prior to and during a sampling event.

Field QC Sample -- Used to detect for contamination or error in the field.

Field Sample -- Primary sample material taken out in the field from which other samples, such as duplicates or split samples are derived. A field sample can be prepared in the field and sent for analysis in one or multiple containers, and is identified by a unique EPA Sample Number.

Field Sampling Plan (FSP) -- Developed to outline the actual steps and requirements pertaining to a particular sampling event, and explains, in detail, each component of the event to all involved samplers.

Holding Time -- The elapsed time expressed in hours, days, or months from the date of collection of the sample until the date of its analysis.

Contractual -- The lengths of time that the CLP laboratory must follow to comply with the terms of the contract, and are described in the CLP analytical services Statements of Work (SOWs).

Technical -- The maximum lengths of time that samples may be held from time of collection to time of preparation and/or analysis and still be considered valid.

Laboratory Blank -- See Method Blank.

Laboratory Duplicate -- A sample required by the laboratory's contract to check the precision of inorganic analyses.

Laboratory QC Sample -- An additional volume of an existing sample, as required by the laboratory's contract, used to detect contamination or error in the laboratory's practices.

Matrix -- The predominant material of which a sample to be analyzed is composed.

Matrix Spike (MS) -- Sample required by the laboratory's contract to check the accuracy of organic and inorganic analyses. It is an aliquot of a sample (water or soil) that is fortified (spiked) with known quantities of a specific compound and subjected to the entire analytical procedure. See Matrix Spike Duplicate.

Matrix Spike Duplicate (MSD) -- Sample required by the laboratory's contract to check the accuracy and precision of organic analyses. It is a second aliquot of the same matrix as the Matrix Spike (MS) that is spiked to determine the precision of the method. See Matrix Spike.

Method Blank -- An analytical control consisting of all reagents, internal standards and surrogate standards [or System Monitoring Compounds (SMCs) for volatile organic analysis], that is carried throughout the entire analytical procedure. The method blank is used to define the level of laboratory, background, and reagent contamination, also referred to as laboratory blank when defining the level of laboratory contamination.

Performance Evaluation (PE) Sample -- A sample of known composition provided by the USEPA for contractor analysis. Used by USEPA to evaluate contractor performance.

Pesticides -- Substances intended to repel, kill, or control any species designated a "pest", including weeds, insects, rodents, fungi, bacteria, and other organisms. Under the CLP, only organochlorine pesticides are analyzed (e.g., DDT, Dieldrin, Endrin, etc.).

Polychlorinated Biphenyls (PCBs) -- A group of toxic, persistent chemicals used in electrical transformers and capacitors for insulating purposes, and in gas pipeline systems as a lubricant. The sale and new use of PCBs were banned by law in 1979.

Quality Assurance (QA) -- An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the customer.

Quality Assurance Project Plan (QAPP) -- Document written to meet requirements outlined in the document *EPA Guidance for Quality Assurance Project Plans* (EPA QA/R-5). Prepared in advance of field activities and used by samplers to develop any subsequent plans such as the Sampling Analysis Plan (SAP) or the Field Sampling Plan (FSP).

Quality Control (QC) -- The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality.

Regional Sample Control Center (RSCC) Coordinator -- In most Regions, coordinates sampling efforts and serves as the central point-of-contact for sampling questions and problems. Also assists in coordinating the level of Regional sampling activities to correspond with the monthly projected demand for analytical services.

Regional Site Manager -- Coordinates the development of data quality objectives and oversees project-specific remedial or removal contractors, State officials, or private parties conducting site sampling efforts.

Rinse Blank -- A sample used to check decontamination procedures. Also see Field Blank.

Routine Analytical Service (RAS) -- The standard inorganic and organic analyses available through the CLP.

Sample -- A discrete portion of material to be analyzed that is contained in single or multiple containers, and identified by a unique Sample Number.

Sample Delivery Group (SDG) -- A unit within a sample Case that is used to identify a group of samples for delivery. An SDG is defined by the following, whichever is most frequent:

- Each Case of field samples received; or
- Each 20 field samples (excluding PE samples) within a Case; or
- Each 7 calendar day period (3 calendar day period for 7-day turnaround) during which field samples in a Case are received (said period beginning with the receipt of the first sample in the SDG).

In addition, all samples and/or sample fractions assigned to an SDG must have been scheduled under the same contractual turnaround time. Preliminary Results have no impact on defining the SDG. Sample may be assigned to SDGs by matrix (e.g., all soil samples in one SDG, all water samples in another) at the discretion of the laboratory.

Sample Label -- An identification label attached to a sample bottle or container to identify the sample.

Sample Number -- A unique number used to identify and track a sample. This number can be recorded on a sample label or written on the sample bottle or container using indelible ink.

Sample Tag -- A tag attached to a sample that identifies the sample and maintains chain-of-custody.

Sampling Analysis Plan (SAP) -- A document that explains how samples are to be collected and analyzed for a particular sampling event.

Semivolatile Organic Analyte (SVOA) -- A compound amenable to analysis by extraction of the sample using an organic solvent.

Statement of Work (SOW) -- A document that specifies how laboratories analyze samples under a particular Contract Laboratory Program (CLP) analytical program.

Superfund -- The program operated under the legislative authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Superfund Amendments and Reauthorization Act (SARA) that funds and carries out USEPA removal and remedial activities at hazardous waste sites. These activities include establishing the National Priorities List (NPL), investigating sites for inclusion on the list, determining their priority, and conducting and/or supervising cleanup and other remedial actions.

Superfund Amendments and Reauthorization Act (SARA) -- The 1986 amendment to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Traffic Report/Chain of Custody (TR/COC) Record -- A record that is functionally similar to a packing slip that accompanies a shipment of goods. Used as physical evidence of sample custody and functions as a permanent record for each sample collected.

Trip Blank -- A sample used to check for contamination during sample handling and shipment from field to laboratory. Also see Field Blank.

Volatile Organic Analyte (VOA) -- A compound amenable to analysis by the purge-and-trap technique. Used synonymously with the term purgeable compound.

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APPENDIX B
SITE-SPECIFIC DATA QUALITY OBJECTIVES

DATA QUALITY OBJECTIVE NO. 1
JACKPILE-PAGUATE URANIUM MINE
MEDIA OF CONCERN: GROUNDWATER

STEP 1. STATE THE PROBLEM	
Uranium and other metals/radionuclides from mine tailings may be migrating to surface water and/or groundwater at the former Jackpile Mine representing a threat to human health and the environment.	
STEP 2. IDENTIFY THE DECISION	
Groundwater samples will be collected from upgradient, on-site, and downgradient of the mine area to determine whether contaminants of concern (CoCs) identified during the 2010 SI sampling event are significantly elevated in groundwater with respect to background concentrations. In addition, general water chemistry analyses are needed to update a hydrologic model of the site.	
IDENTIFY THE ALTERNATIVE ACTIONS THAT MAY BE TAKEN BASED ON THE DECISIONS.	<ul style="list-style-type: none"> • If concentrations of CoCs are significantly elevated with respect to background in groundwater monitoring wells constructed on-site, and downgradient of, the site, then an observed release to groundwater has been established. • If concentrations of CoCs in groundwater samples are not significantly elevated with respect to background, then an area of observed contamination has not been established. • General water chemistry data will be used to update the hydrologic model of the site.
STEP 3. IDENTIFY INPUTS TO THE DECISION	
IDENTIFY THE INFORMATIONAL INPUTS NEEDED TO RESOLVE A DECISION.	<ul style="list-style-type: none"> • Review historical site operations contributing to contamination. • Historical groundwater and surface water data collected at the site. • Contaminant concentrations in waste soil samples collected during 2010 SI sampling. • New groundwater sampling during this ESI.
IDENTIFY THE SOURCES FOR EACH INFORMATIONAL INPUT AND LIST THE INPUTS THAT ARE OBTAINED THROUGH ENVIRONMENTAL MEASUREMENTS.	<ul style="list-style-type: none"> • Existing groundwater monitoring well locations as shown in Figure 3-1. • Inorganic chemical analyses for Total Dissolved Solids by EPA Method 160.1, TAL metals by 6010/7470, and General Anion Chemistry by EPA Method 9056. • Radionuclide analysis for uranium isotopic species by Alpha Spec ASTM 3972-90M, Gross Alpha, Beta, and Gamma by EPA Method 9310, and Radium 226 +228 by EPA Method 903.1.
BASIS FOR THE CONTAMINANT SPECIFIC ACTION LEVELS.	For an observed release, contaminants must be detected at concentrations greater than three-times (>3X) background for an analyte that is detected in background samples, or detected where the analyte is not detected in background samples.

DATA QUALITY OBJECTIVE NO. 1
JACKPILE-PAGUATE URANIUM MINE
MEDIA OF CONCERN: GROUNDWATER

IDENTIFY POTENTIAL SAMPLING TECHNIQUES AND APPROPRIATE ANALYTICAL METHODS.	<ul style="list-style-type: none"> Groundwater samples will be collected in accordance with US EPA Groundwater Sampling Compendium, OSWER 9360.4-06 and Weston Groundwater Sampling SOP 1002-02. Inorganic chemical analyses for Total Dissolved Solids by EPA Method 160.1, TAL metals by EPA Method 6010/7470, and General Cation/Anion Chemistry by EPA Method 9056. Radionuclide analysis for uranium isotopic species by Alpha Spec ASTM 3972-90M, Gross Alpha, Beta, and Gamma by EPA Method 9310, and Radium 226 + 228 by EPA Method 903.1.
STEP 4. DEFINE THE BOUNDARIES OF THE STUDY	
DEFINE THE DOMAIN OR GEOGRAPHIC AREA WITHIN WHICH ALL DECISIONS MUST APPLY.	Selected groundwater monitoring wells located on site, up to one mile up gradient, and up to five miles downgradient of the site.
SPECIFY THE CHARACTERISTICS THAT DEFINE THE POPULATION OF INTEREST.	<ul style="list-style-type: none"> Groundwater includes the Alluvial Aquifer, which is associated with the active surface water system, and the Jackpile Aquifer, which is partially confined and has a distinct water chemistry.
DEFINE THE SCALE OF DECISION MAKING.	Results of groundwater and surface water sampling will be used to evaluate the groundwater-to-surface water pathway to the HRS evaluation.
DETERMINE THE TIME FRAME TO WHICH THE DATA APPLY.	The data will apply until the site media, represented by the waste, groundwater, and surface water samples, receives appropriate remedial actions.
DETERMINE WHEN TO COLLECT DATA.	Samples will be collected during the START-3 field effort and prior to HRS evaluation. This should take place during the period of low evapotranspiration – during the months of October to April.
IDENTIFY PRACTICAL CONSTRAINTS ON DATA COLLECTION.	<ul style="list-style-type: none"> Inclement weather. Access not attainable. Wells destroyed or inoperable Vicious attack elk
STEP 5. DEVELOP A DECISION RULE	
SPECIFY THE PARAMETER THAT CHARACTERIZES THE POPULATION OF INTEREST.	Detection of CoCs in the water samples by analytical testing to confirm concentrations in the pathway that are significantly elevated with respect to background.

DATA QUALITY OBJECTIVE NO. 1
JACKPILE-PAGUATE URANIUM MINE
MEDIA OF CONCERN: GROUNDWATER

SPECIFY THE ACTION LEVEL FOR THE DECISION.	<ul style="list-style-type: none"> • The results of the 2010 SI indicate that COCs identified in the waste soil samples are CERCLA hazardous substances as defined in CERCLA Sections 101(14) and 101(33); therefore, an area of observed contamination has been established. • If COCs are detected in on-site and downgradient groundwater at concentrations that are significantly elevated with respect to background, then an observed release has been established. The data will contribute to the HRS scoring. • If COCs in the groundwater samples are either not detected at concentrations significantly elevated with respect to background, then an observed release has not been established. The surface water and/or groundwater-to-surface water pathways will not contribute to the HRS scoring.
STEP 6. SPECIFY LIMITS ON DECISION ERRORS	
DEVELOP A DECISION RULE.	<ul style="list-style-type: none"> • If site and/or downgradient groundwater samples have CoCs that are detected at elevations that are significantly above background concentrations, then an observed release to the groundwater pathway has been established.
DETERMINE THE POSSIBLE RANGE OF THE PARAMETER OF INTEREST.	Contaminant concentrations may range from 0 µg/mg to more than the contaminant specific action level.
DEFINE BOTH TYPES OF DECISION ERRORS AND IDENTIFY THE POTENTIAL CONSEQUENCES OF EACH.	<p><u>Type I Error:</u> Deciding that the specified area represented by the groundwater sample does not exceed the specified assessment level when, in truth, the concentration of the contaminant exceeds its specified assessment level. The consequence of this decision error is that remedial efforts in the watershed may not be undertaken, possibly endangering human health and the environment. This decision error is more severe.</p> <p><u>Type II Error:</u> Deciding that the specified area represented by the groundwater sample does exceed the specified assessment level when, in truth, it does not. The consequences of this decision error are that remediation of the watershed will continue and unnecessary costs will be incurred.</p>
ESTABLISH THE TRUE STATE OF NATURE FOR EACH DECISION RULE.	<p>The true state of nature when the groundwater is decided to be below the specified assessment levels when in fact, it is not below the specified assessment levels, is that the watershed does need remedial action.</p> <p>The true state of nature when the groundwater is decided to be above the specified assessment levels when in fact, it is not above the specified assessment levels, is that the watershed does not need remedial action.</p>

DATA QUALITY OBJECTIVE NO. 1
JACKPILE-PAGUATE URANIUM MINE
MEDIA OF CONCERN: GROUNDWATER

STEP 6. SPECIFY LIMITS ON DECISION ERRORS (Continued)	
DEFINE THE TRUE STATE OF NATURE FOR THE MORE SEVERE DECISION ERROR AS THE BASELINE CONDITION OR THE NULL HYPOTHESIS (H_0) AND DEFINE THE TRUE STATE FOR THE LESS SEVERE DECISION ERROR AS THE ALTERNATIVE HYPOTHESIS (H_a).	<p>H_0: The water represented by the sample is above the specified action level.</p> <p>H_a: The water represented by the sample is below the specified action level.</p>
ASSIGN THE TERMS "FALSE POSITIVE" AND "FALSE NEGATIVE" TO THE PROPER DECISION ERRORS.	<ul style="list-style-type: none"> False Positive Error = Type I False Negative Error = Type II
ASSIGN PROBABILITY VALUES TO POINTS ABOVE AND BELOW THE ACTION LEVEL THAT REFLECT THE ACCEPTABLE PROBABILITY FOR THE OCCURRENCES OF DECISION ERRORS.	To be assigned based on discussions with EPA SAM.
STEP 7. OPTIMIZE THE DESIGN	
REVIEW THE DQOs.	Due to insufficient historical data, determination of the standard deviation was not possible. Therefore, sample size calculation using the traditional statistical formula may not be the optimal design. In order to select the optimal sampling program that satisfies the DQOs and is the most resource effective, other elements were considered.
<p>DEVELOP GENERAL SAMPLING AND ANALYSIS DESIGN.</p> <p>Up to fourteen groundwater samples will be collected from existing monitoring wells completed at locations upgradient, on-site, and downgradient of the Jackpile-Paguate Uranium Mine site. The samples will be analyzed for CoCs to determine the presence of hazardous substances as defined by CERCLA, and to show potential attribution to the pathways of concern used for HRS evaluation. The samples will be analyzed for uranium isotopes, TAL metals, gross alpha, beta, and gamma, and radium. In addition, water samples will be analyzed for general cation/anion chemistry and total dissolved solids.</p>	

DATA QUALITY OBJECTIVE NO. 2
JACKPILE-PAGUATE URANIUM MINE
MEDIA OF CONCERN: SURFACE WATER/SEDIMENT

STEP 1. STATE THE PROBLEM	
Are surface water/sediment samples collected from the surface water pathway above three times the maximum background concentrations resulting in an observed release?	
STEP 2. IDENTIFY THE DECISION	
Are the concentrations of chemicals of concern in surface water/sediment, represented by a sample, above three times the maximum background concentrations?	
IDENTIFY THE ALTERNATIVE ACTIONS THAT MAY BE TAKEN BASED ON THE DECISIONS.	<ul style="list-style-type: none"> • If any contaminant exceeds three times the background concentrations in the surface water/sediment, the surface water/sediment represented by that sample will be considered contaminated and will require additional attention. • If no contaminants exceed three times the background concentrations in the surface water/sediment, the surface water/sediment represented by that sample will not require additional attention. • General water chemistry data from surface water will be used to update the hydrologic model of the site.
STEP 3. IDENTIFY INPUTS TO THE DECISION	
IDENTIFY THE INFORMATIONAL INPUTS NEEDED TO RESOLVE A DECISION.	<ul style="list-style-type: none"> • Review historical site operations contributing to contamination. • Historical surface water data collected at the site. • Contaminant concentrations in waste soil samples and surface water samples collected during 2010 SI sampling. • New groundwater sampling during this ESI.
IDENTIFY THE SOURCES FOR EACH INFORMATIONAL INPUT AND LIST THE INPUTS THAT ARE OBTAINED THROUGH ENVIRONMENTAL MEASUREMENTS.	<ul style="list-style-type: none"> • Surface water/Sediment samples from the surface water pathway. • Inorganic chemical analyses for Total Dissolved Solids by EPA Method 160.1, and General Anion Chemistry by EPA Method 9056. • Radionuclide analysis for Gross Alpha, Beta, and Gamma by EPA Method 9310, and Radium 226 +228 by EPA Method 903.1.
BASIS FOR THE CONTAMINANT SPECIFIC ACTION LEVELS.	The site specific screening levels will be three times the maximum background concentrations.
IDENTIFY POTENTIAL SAMPLING TECHNIQUES AND APPROPRIATE ANALYTICAL METHODS.	<ul style="list-style-type: none"> • Grab surface water/sediment samples from the surface water pathway analyzed for: • General Anion Chemistry by EPA Method 9056 • Gross Alpha, Beta, and Gamma by EPA Method 9310 • Radium 226 +228 by EPA Method 903.1
STEP 4. DEFINE THE BOUNDARIES OF THE STUDY	
DEFINE THE DOMAIN OR GEOGRAPHIC AREA WITHIN WHICH ALL DECISIONS MUST APPLY.	The boundaries for the Jackpile-Paguate Uranium Mine site are shown along with the proposed surface water/sediment sample locations in Figure 3-1.

DATA QUALITY OBJECTIVE NO. 2
JACKPILE-PAGUATE URANIUM MINE
MEDIA OF CONCERN: SURFACE WATER/SEDIMENT

SPECIFY THE CHARACTERISTICS THAT DEFINE THE POPULATION OF INTEREST.	Contaminant concentrations in surface water/sediments at the sample locations.
DEFINE THE SCALE OF DECISION MAKING.	The scale of decision will be for the site activities occurring at the time of the sample collection.
DETERMINE THE TIME FRAME TO WHICH THE DATA APPLY.	The analytical data will apply until the surface water/sediment represented by the sample receives appropriate response action.
STEP 4. DEFINE THE BOUNDARIES OF THE STUDY (Continued)	
DETERMINE WHEN TO COLLECT DATA.	Surface water/sediment samples will be collected during the field sampling activities.
IDENTIFY PRACTICAL CONSTRAINTS ON DATA COLLECTION.	<ul style="list-style-type: none"> • Inclement weather. • Access not attainable.
STEP 5. DEVELOP A DECISION RULE	
SPECIFY THE PARAMETER THAT CHARACTERIZES THE POPULATION OF INTEREST.	The sample concentrations at each sample location will be compared to three times the maximum background concentrations.
SPECIFY THE ACTION LEVEL FOR THE DECISION.	The site specific screening levels will be three times the maximum background concentrations.
DEVELOP A DECISION RULE.	If any result in a surface water/sediment sample is above three times the maximum background concentrations, then the surface water/sediment represented by that sample will require additional attention, otherwise the surface water/sediment does not require additional attention. Additional attention means more sampling, surface water/sediment collection and treatment, or other action deemed necessary by EPA.
STEP 6. SPECIFY LIMITS ON DECISION ERRORS	
DETERMINE THE POSSIBLE RANGE OF THE PARAMETER OF INTEREST.	Contaminant concentrations may range from 0 mg/kg for surface water/sediment to more than three times the maximum background concentrations.
DEFINE BOTH TYPES OF DECISION ERRORS AND IDENTIFY THE POTENTIAL CONSEQUENCES OF EACH.	<p><u>Type I Error:</u> Deciding that the specified area represented by the surface water/sediment sample does not exceed three times the maximum background concentrations when, in truth, the surface water/sediment concentration of the contaminant exceeds three times the maximum background concentrations. The consequence of this decision error is that contaminated surface water/sediment will remain in place, possibly endangering human health and the environment. This decision error is more severe.</p> <p><u>Type II Error:</u> Deciding that the specified area represented by the surface water/sediment sample does exceed three times the maximum background concentrations when, in truth, it does not. The consequences of this decision error are that remediation of the surface water/sediment will continue and unnecessary costs will be incurred.</p>

DATA QUALITY OBJECTIVE NO. 2
JACKPILE-PAGUATE URANIUM MINE
MEDIA OF CONCERN: SURFACE WATER/SEDIMENT

STEP 6. SPECIFY LIMITS ON DECISION ERRORS (Continued)	
ESTABLISH THE TRUE STATE OF NATURE FOR EACH DECISION RULE.	The true state of nature when the surface water/sediment is decided to be below three times the maximum background concentrations when in fact, it is not below three times the maximum background concentrations, is that the surface water/sediment does need remedial action. The true state of nature when the surface water/sediment is decided to be above three times the maximum background concentrations when in fact, it is not above three times the maximum background concentrations, is that the surface water/sediment does not need remedial action.
DEFINE THE TRUE STATE OF NATURE FOR THE MORE SEVERE DECISION ERROR AS THE BASELINE CONDITION OR THE NULL HYPOTHESIS (H_0) AND DEFINE THE TRUE STATE FOR THE LESS SEVERE DECISION ERROR AS THE ALTERNATIVE HYPOTHESIS (H_a).	Ho: The surface water/sediment represented by the sample is above three times the maximum background concentrations. Ha: The surface water/sediment represented by the sample is below three times the maximum background concentrations.
ASSIGN THE TERMS "FALSE POSITIVE" AND "FALSE NEGATIVE" TO THE PROPER DECISION ERRORS.	<ul style="list-style-type: none"> False Positive Error = Type I False Negative Error = Type II
ASSIGN PROBABILITY VALUES TO POINTS ABOVE AND BELOW THE ACTION LEVEL THAT REFLECT THE ACCEPTABLE PROBABILITY FOR THE OCCURRENCES OF DECISION ERRORS.	The assignment of probability values is not applicable to these DQOs because a nonprobabilistic (judgment-based) process has been specified.
STEP 7. OPTIMIZE THE DESIGN	
REVIEW THE DQOs.	Surface water/sediment sample locations were selected based on the location of on-site waste source areas and proximity of the probable point of entry (PPEs) along the surface water pathway.
DEVELOP GENERAL SAMPLING AND ANALYSIS DESIGN. Up to ten surface water and sediment samples will be collected from locations along the surface water pathway. The samples will be analyzed for CoCs to determine the presence of hazardous substances as defined by CERCLA, and to show potential attribution to the pathways of concern used for HRS evaluation. The samples will be analyzed for uranium isotopes, TAL metals, gross alpha, beta, and gamma, and radium. In addition, water samples will be analyzed for general cation/anion chemistry and total dissolved solids.	

APPENDIX C

WESTON AND ERT STANDARD OPERATING PROCEDURES

SOP	1001.01				
GROUP	Sampling Procedures				
SUB-GROUP	Soil Sampling Procedures				
TITLE	Surface Soil Sampling				
DATE	11/19/2001	FILE	1001-01.DOC	PAGE	1 of 3

INTRODUCTION

The following Standard Operating Procedure (SOP) is to describe the procedures for collecting representative soil samples. Analysis of soil samples may determine whether concentrations of specific soil pollutants exceed established action levels, or if the concentrations of soil pollutants present a risk to public health, welfare, or the environment. This SOP is similar to SOP Number 1001.03 for collecting near surface soil samples with a hand auger.

PROCEDURE

Surface soil samples may be collected using a variety of methods and equipment. The methods and equipment used are dependent on the depth of the desired sample, the type of sample required (disturbed versus undisturbed), and the type of soil. Near-surface soils may be easily sampled using a spade, trowel, or hand scoop.

Sample Preservation

Cooling to $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$, supplemented by a minimal holding time, is suggested.

Interferences and Potential Problems

There are two primary interferences or potential problems associated with soil sampling: cross-contamination of samples and improper sample collection. Cross-contamination problems can be eliminated or minimized through the use of dedicated (disposable) sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Improper sample collection can involve using contaminated equipment, disturbance of the matrix resulting in compaction of the sample, or inadequate homogenization of the samples where required, resulting in variable, non-representative results. Homogenization may also affect sample representativeness where the analytical requirements include volatile organic compounds.

Equipment or Apparatus

The equipment used for sampling may be selected from the following list, as appropriate:

- Tape measure
- Survey stakes or flags
- Stainless steel, plastic, or other appropriate homogenization bucket or bowl
- Ziploc plastic bags
- Logbook
- Labels
- Chain-of-custody forms and seals
- Coolers
- Ice
- Decontamination supplies and equipment
- Canvas or plastic sheet
- Spatulas/spades/shovels
- Scoops

SOP	1001.01				
GROUP	Sampling Procedures				
SUB-GROUP	Soil Sampling Procedures				
TITLE	Surface Soil Sampling				
DATE	11/19/2001	FILE	1001-01.DOC	PAGE	2 of 3

- Plastic or stainless steel spoons
- Trowel

Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and what equipment and supplies are required.
2. Obtain necessary sampling and monitoring equipment from the list above.
3. Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.
4. Perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.
5. Decontaminate or preclean equipment, and ensure that it is in working order.
6. Use stakes, buoys, or flagging to identify and mark all sampling locations. Consider specific site factors, including extent and nature of contaminant, when selecting sample locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. All staked locations will be utility-cleared by the property owner or other responsible party prior to soil sampling.
7. Evaluate safety concerns associated with sampling that may require use of personal protective equipment and/or air monitoring.

Surface Soil Sample Collection

Collect samples from the near-surface soil with tools such as spades, shovels, and scoops. Surface material can be removed to the required depth with this equipment, then a stainless steel or plastic scoop can be used to collect the sample. The use of a flat, pointed mason trowel to cut a block of the desired soil can be helpful when undisturbed profiles are required. A stainless steel scoop, lab spoon, or plastic spoon will suffice in most other applications. Avoid the use of devices plated with chrome or other target analyte materials.

The following procedures should be followed when collecting surface soil samples:

1. Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade.
2. Using a pre-cleaned, stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade.
3. If volatile organic analysis is to be performed, transfer a portion of the sample directly into an appropriate, labeled sample container(s) with a stainless steel lab spoon, plastic lab spoon, or equivalent and secure the cap(s) tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into an appropriate, labeled container(s) and secure the cap(s) tightly; or if composite samples are to be collected, place a sample from another sampling interval into the

SOP	1001.01				
GROUP	Sampling Procedures				
SUB-GROUP	Soil Sampling Procedures				
TITLE	Surface Soil Sampling				
DATE	11/19/2001	FILE	1001-01.DOC	PAGE	3 of 3

homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled container(s) and secure the cap(s) tightly.

4. Fill hole created through sampling with unused material or other appropriate backfill material (sand).
5. Record applicable information into field log book or appropriate forms as documentation of sampling.

SOP	1001.04				
GROUP	Sampling Procedures				
SUB-GROUP	Soil Sampling Procedures				
TITLE	Sampling of Stockpiled Soil				
DATE	11/19/2001	FILE	1001-04.DOC	PAGE	1 of 1

INTRODUCTION

The following Standard Operating Procedure (SOP) describes the procedure for collecting representative samples of stockpiled soil. Representative soil samples may be collected for analysis to determine whether concentrations of specific soil pollutants exceed established action levels, or if the concentrations of soil pollutants present a risk to public health and welfare, or the environment. Soil samples are also typically collected from stockpiles for classification prior to entry into a soil treatment process or offsite disposal, or after treatment to verify the effectiveness of the treatment system. This soil sampling procedure is closely related to SOP Nos. 1001.01, 1001.03, and 1001.10 regarding soil sampling procedures.

PROCEDURE

Stockpiles will be sampled as follows:

- Soil may be collected from the surface of a stockpile using the surface soil sampling procedure (SOP 1001.01) or from deeper within the stockpile according to the hand augering procedure (SOP 1001.03) as appropriate to obtain the required soil material. The procedure to be used to physically collect soil samples from stockpiles are described in SOP Nos. 1001.01, 1001.03, and 1001.10 (soil compositing). Reference should be made to these SOPs for specific sampling equipment, procedures, and other general guidelines. Equipment that may be used as part of the soil compositing procedure is identified under SOP Nos. 1001.01 and 1001.03 where general soil sampling methods are described.
- Each project may have different stockpile sampling objectives and requirements. Therefore, the sampling of stockpiles should be addressed in a site-specific Sampling and Analysis Plan and the soil sampling implemented in accordance with this plan.
- Samples may be collected from discrete locations in a pile and submitted for laboratory analysis, as described in SOP Nos. 1001.01 and 1001.03. More typical is that several samples from a single stockpile will be collected and composited to prepare a single sample for laboratory analysis. Collecting composite samples from a stockpile is recommended and will generally be performed to better characterize the soil in the pile. The number of samples to collected from a stockpile and composite will depend on the size of the stockpile and the particular requirements of the project. Typically compositing for characterization purposes is on the order of 1 composite soil sample for every 50 cubic yards. Compositing will be performed in accordance with SOP 1001.10.

REFERENCES

SOP No. 1001.01 - Standard Operating Procedure, Surface Soil Sampling

SOP No. 1001.03 - Standard Operating Procedure, Shallow Subsurface and Near Surface Soil Sampling

SOP No. 1001.10 - Standard Operating Procedure, Soil Compositing

SOP	1001.10				
GROUP	Soil Sampling Procedures				
SUB-GROUP					
TITLE	Soil Compositing				
DATE	2/23/2010	FILE	1001-10.DOC	PAGE	1 of 2

INTRODUCTION

The following Standard Operating Procedure (SOP) describes the procedure for compositing soil samples. Soil samples are typically collected for laboratory analysis, and sometimes it is necessary to composite (mix together) samples from several locations for one combined analysis at the laboratory. This soil sampling procedure is closely related to SOP Nos. 1001.01, 1001.03, and 1001.10 regarding soil sampling procedures. This procedure serves as an alternative method of sample preparation prior to placing the samples in containers, as described in the other named SOPs.

PROCEDURE

Equipment

Equipment that may be used as part of the soil compositing procedure is identified under SOP Nos. 1001.01 and 1001.03 where soil sampling methods are described. Specific equipment typically used during the compositing process after discrete samples are collected includes:

- Mixing bowls or buckets
- Scoops, spatulas, and knives
- Sample containers
- Personal protection clothing
- Plastic Sheeting
- Decontamination equipment and supplies

Method

The procedure to be used to physically collect soil samples are described in SOP Nos. 1001.01 and 1001.03. Reference should be made to these SOPs for specific sampling equipment, procedures, and other general guidelines. As soil samples are collected, the site-specific Sampling and Analysis Plan may required compositing (mixing together) of two or more samples to create a single sample that will be sent to the laboratory for analysis. When this is the case, the following compositing procedure will generally be used:

- The soil will be collected in general accordance with SOP 1001.01 or 1001.03, with the exception that samples from discrete locations will generally not be immediately placed into sample containers and an additional preparation step (i.e., compositing) will be performed.
- As they are collected, soil samples selected for compositing will be staged in a clean mixing bowl or mixing bucket until each sample to be included in the composite sample is obtained. Depending on site requirements and analytical procedures to be requested, it may be necessary to temporarily stage individual discrete-location samples within clean sample jars, aluminum foil, or other appropriate materials for the project. The method for sample staging should be specified in the site-specific sampling and analysis plan.

SOP	1001.10				
GROUP	Soil Sampling Procedures				
SUB-GROUP					
TITLE	Soil Compositing				
DATE	2/23/2010	FILE	1001-10.DOC	PAGE	2 of 2

- For composite samples that will be analyzed for volatile organic compounds, an equal portion of soil will be removed directly from each discrete-location sample and placed into a final sample jar without homogenizing the soil.
- For analyses other than volatile organics, equal portions of soil will be removed from each discrete-location sample and placed in a clean mixing bowl. The equal portions of the samples will then be broken up and homogenized together using a scoop or spatula. Homogenization will generally continue until the discrete samples being combined are reasonably indistinguishable as individual individual samples in the soil mixture. However, it is recognized that homogenization can be difficult for highly plastic clays. In this case, equal amounts of the the soil core of each clay sample will be cut into small, roughly cubical pieces using a stainless steel knife, and an equal numbers of pieces of each discrete sample will be placed into the bowl and homogenized to extent practical.
- The composited soil sample will be collected from the mixing bowl containing the individual homogenized samples after homogenization is performed. The composited sample will be collected using a stainless steel or disposable plastic scoop or similar tool. The sample will be placed in a clean sample container and then handled in accordance with soil sampling SOPs 1001.01 and 1001.03.

Variations on this procedure are allowable to accomodate different soil conditions and any site requirements specifically identified in the site-specific Sampling and Analysis Plan.

The number of discrete samples that may be composited into a single sample typically ranges from two to six. The number of discrete samples that may be composited for the project in question will be specified in the site-specific Sampling and Analysis Plan.

REFERENCES

SOP No. 1001.01 - Standard Operating Procedure, Surface Soil Sampling

SOP No. 1001.03 - Standard Operating Procedure, Shallow Subsurface and Near Surface Soil Sampling

SOP	1002.01				
GROUP	Sampling Procedures				
SUB-GROUP	Surface Water				
TITLE	Surface Water Sampling				
DATE	11/19/2001	FILE	1002-01.DOC	PAGE	1 of 3

INTRODUCTION

The following Standard Operating Procedure (SOP) is to describe the procedures for collecting representative surface water samples. Analysis of surface samples may determine whether concentrations of specific soil pollutants exceed established action levels, or if the concentrations of pollutants present a risk to public health, welfare, or the environment.

PROCEDURE

Surface water samples may be collected using a variety of methods and equipment. The methods and equipment used are usually dependent on the location of the body of water being sampled. Sampling can be performed by merely submerging the sample container, a weighted-bottle sampler with stopper, a bailer, or by pump assisted methods. Several types of pumps can be used for sampling depending on the objectives of sampling and the site conditions.

Sample Preservation

Samples are to be preserved in conformance with the site-specific Quality Assurance Project Plan, Sampling and Analysis Plan or work plan. In general these requirements include refrigeration to 4°C, addition of appropriate additives (HCl, H₂SO₄, NaOH) to adjust and fix pH, and a defined maximum holding time. If a site-specific plan is not available, the analytical laboratory should be consulted for the appropriate preservation procedures.

Interferences and Potential Problems

There are two primary interferences or potential problems associated with surface water sampling: cross-contamination of samples and improper sample collection. Cross-contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Improper sample collection can involve using contaminated equipment, undue disturbance of the sample matrix, or improper sample location.

Equipment or Apparatus

- Ziploc plastic bags
- Logbook
- Labels
- Chain-of-custody forms and seals
- Coolers
- Ice
- Decontamination supplies and equipment
- Discharge tubing
- Sample containers
- Sampling devices

SOP	1002.01				
GROUP	Sampling Procedures				
SUB-GROUP	Surface Water				
TITLE	Surface Water Sampling				
DATE	11/19/2001	FILE	1002-01.DOC	PAGE	2 of 3

Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are required.
2. Obtain necessary sampling and monitoring equipment.
3. Decontaminate or preclean equipment, and ensure that it is in working order.
4. Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.
5. Perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.

Surface Water Sampling

Samples from shallow depths can be readily collected by merely submerging the sample container. In flowing surface water bodies, the container's mouth should be positioned so that it faces upstream, while the sampling personnel stand downstream so as not to stir up sediment that could potentially contaminate the sample.

Collecting a representative sample from a larger body of surface water requires that samples be collected near the shore unless boats are feasible and permitted. If boats are used, the body of water should be cross sectioned, and samples should be collected at various depths across the body of water in accordance with the specified sampling plan. For this type of sampling, a weighted-bottle sampler is used to collect samples at a predetermined depth. The sampler consists of a glass bottle, a weighted sinker, a bottle stopper, and a line that is used to open the bottle and to lower and raise the sampler during sampling. The procedure for use is as follows:

- Assemble the weighted bottle sampler.
- Gently lower the sampler to the desired depth so as not to remove the stopper prematurely.
- Pull out the stopper with a sharp jerk of the sampler line.
- Allow the bottle to fill completely, as evidenced by the cessation of air bubbles.
- Raise the sampler and cap the bottle.
- Wipe the bottle clean. The sampling bottle can be also be used as the sample container for shipping.

Teflon bailers have also been used where feasible for collecting samples in deep bodies of water.

SOP	1002.01				
GROUP	Sampling Procedures				
SUB-GROUP	Surface Water				
TITLE	Surface Water Sampling				
DATE	11/19/2001	FILE	1002-01.DOC	PAGE	3 of 3

Another method of extending the reach of sampling efforts is the use of a small peristaltic pump. In this method the sample is drawn through heavy-wall Teflon tubing and pumped directly into the sample container. This system allows the operator to reach into the liquid body, sample from depth, or sweep the width of narrow streams.

The general sampling procedures are listed below:

1. Collect the sample using whichever technique, submerged bottle, bottle sampler with stopper, pump & tubing, or bailer.
2. The collected sample may be collected in the sample containers or may be transferred to the appropriate sample containers in order of the volatile organics first and inorganics last.
3. Label sample containers, place on ice in a cooler, remove, and decontaminate equipment as necessary.

REFERENCES

SOP 0110.01 Sample Nomenclature
SOP 1005.01 Field Duplicate Collection
SOP 1005.02 Rinse Blank Preparation
SOP 1005.03 Field Blank Preparation
SOP 1101.01 Sample Custody - Field
SOP 1102.01 Sample Shipping
SOP 1201.01 Sampling Equipment Decontamination
SOP 1501.01 Field Logbook

SOP	1002.02				
GROUP	Sampling Procedures				
SUB-GROUP	Water Sampling Procedures				
TITLE	Groundwater Sampling				
DATE	11/19/2001	FILE	1002-02.DOC	PAGE	1 of 3

INTRODUCTION

The following Standard Operating Procedure (SOP) is to describe the procedures for collecting representative groundwater samples. Analysis of groundwater samples may determine whether concentrations of specific pollutants exceed established action levels, or if the concentrations of pollutants present a risk to public health, welfare, or the environment. This SOP applies to collection of groundwater samples from monitoring wells and/or piezometers.

PROCEDURE

Groundwater samples may be collected using a variety of methods and equipment. The methods and equipment used are dependent on the depth of the piezometric level from the ground surface and the particular analytes of concern. For example, deep monitoring wells are typically purged and sampled using submersible pumps and shallow monitoring wells are typically purged and sampled using bailing techniques.

Sample Preservation

Preservation depends on the particular analyte or analyte group as specified in EPA approved analytical methods. In almost all cases, cooling to $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$, supplemented by a minimal holding time is required.

Interferences and Potential Problems

There are two primary interferences or potential problems associated with groundwater sampling: cross-contamination of samples and improper sample collection. Cross-contamination problems can be eliminated or minimized through the use of dedicated (disposable) sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Improper sample collection can involve using contaminated equipment, inadequate purging of static and potentially unrepresentative water from the well, improper purging and sampling methods (creating turbidity problems), and improper handling of samples allowing atmospheric alteration and non-representative results (i.e. volatilization).

Equipment or Apparatus

The equipment used for sampling may be selected from the following list, as appropriate:

- Water level indicator
- Drums or buckets as appropriate to contain purge water
- Ziploc plastic bags
- Logbook
- Labels
- Chain-of-custody forms and seals
- Coolers
- Ice
- Decontamination supplies and equipment
- Canvas or plastic sheet

SOP	1002.02				
GROUP	Sampling Procedures				
SUB-GROUP	Water Sampling Procedures				
TITLE	Groundwater Sampling				
DATE	11/19/2001	FILE	1002-02.DOC	PAGE	2 of 3

- Physical monitoring equipment (pH, specific conductivity, temperature, redox potential, and dissolved oxygen measuring devices)
- Bailers (disposable and non-disposable) and bailer rope
- Submersible or peristaltic pumps and associated tubing
- Power supply as appropriate for the selected pump
- Sample containers

Preparation

1. Determine the purpose of the sampling effort, the sampling methods to be employed, and what equipment and supplies are required.
2. Obtain necessary sampling and monitoring equipment from the list above.
3. Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.
4. Perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.
5. Decontaminate or preclean equipment, and ensure that it is in working order.
6. Identify the monitoring wells to be sampled. Consider specific site factors, including extent and nature of contaminant, when selecting sample locations.
7. Evaluate safety concerns associated with sampling that may require use of personal protective equipment and/or air monitoring.

Groundwater Sample Collection

For newly installed monitoring wells and piezometers, sampling should not be performed sooner than 24 hours after development. Prior to sampling, each well/piezometer will be purged to remove static groundwater and allow collection of representative samples. Purging can be performed by either pumping with a submersible pump or peristaltic pump or by bailing with a bailer of appropriate construction. Sampling can be performed directly by whichever method is used. If a submersible pump is used as the sampling device, it will be a variable discharge type, and sampling will be performed at low flow to avoid induced volatilization of constituents (if present) from the impellers. The following procedure will be used for monitoring well/piezometer sampling.

1. Determine the construction details (screen interval, size of borehole, length of filter pack, etc.) of each monitoring well to be sampled. This information can be obtained from well construction diagrams and/or boring logs.
2. Measure and record the static water level and total depth of the well from the top of the well casing (or identified reference point). An oil/water interphase probe will be used to determine the water level and presence of phase-separated product, if present. If phase separated product is present in the well (either NAPL or DNAPL) an evaluation will be performed as to the necessity of sampling either the well or product will be performed. In the event that accumulated sediment is identified in the wells, redevelopment may be necessary prior to sampling.
3. Determine the volume of water to be purged from the well/piezometer.

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GROUP	Sampling Procedures				
SUB-GROUP	Water Sampling Procedures				
TITLE	Groundwater Sampling				
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4. Lay plastic sheeting or canvas around the well to prevent contact of the bailer line or pump cable and tubing with the ground.
5. Evacuate a minimum of three well volumes of water from the well/piezometer. Low flow purging is recommended to reduce agitation and turbidity. In general, three wetted casing plus annular volumes of water are required for successful purging. For instances of low yield, purging to dryness twice is acceptable. Measure and record pH, specific conductivity, temperature and any other indicators of interest throughout purging activities. Purging is considered complete when the volume requirements are satisfied, the physical measurements stabilize (typically 0.5 pH units, 10% specific conductivity, and 1° C temperature), and when the evacuated water is reasonably free of sediment.
6. Allow the well to recover (ideally 75% of the static level), and collect the appropriate groundwater samples. A variable discharge submersible pump, peristaltic pump, or disposable bailer can be used to collect the groundwater samples. All groundwater samples will be collected and transferred to the appropriate labeled sample containers, preserved as necessary, and placed in a cooler with ice.
7. Record applicable information into field log book or appropriate forms as documentation of sampling.
8. Properly package and ship samples to the designated laboratory as soon as possible (typically the same day as collected) following proper chain-of-custody and shipping procedures.

SOP	1002.04				
GROUP	Sampling Procedures				
SUB-GROUP	Soil Sampling Procedures				
TITLE	Sediment Sampling				
DATE	2/23/2010	FILE	1002-04.DOC	PAGE	1 of 3

INTRODUCTION

The following Standard Operating Procedure (SOP) is to describe the procedures for collecting representative sediment samples using a trowel, piston corer, WILDCO KB Core Sampler, a Ponar Grab Sampler, or other similar equipment. Analysis of sediment samples may be performed to determine whether concentrations of specific sediment pollutants exceed established action levels, or if the concentrations of sediment pollutants present a risk to public health, welfare, or the environment.

PROCEDURE

Overview

Sediment samples may be collected using trowels, core and Ponar sampler, or a variety of similar methods and equipment. The methods and equipment used are dependent on the depth of the desired sample, the type of sample required (disturbed versus undisturbed), and the type of sediment (fines versus coarse). Sampling in shallow areas or streams near the surface may only require a hand trowel, while sampling at depth may be performed using a core or Ponar sampler.

Sample Preservation

Refrigeration to $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$, supplemented by a minimal holding time, is suggested.

Interferences and Potential Problems

There are two primary interferences or potential problems associated with sediment sampling: cross-contamination of samples and improper sample collection. Cross-contamination problems can be eliminated or minimized through the use of dedicated (disposable) sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Improper sample collection can involve using contaminated equipment, disturbance of the matrix resulting in mixing of the sample, or inadequate homogenization of the samples where required, resulting in variable, non-representative results. Homogenization may also affect sample representativeness when the analytical requirements include volatile organic compounds.

Equipment or Apparatus

The equipment selected for the sampling effort may include the following as appropriate:

- Tape measure
- Survey stakes or flags
- Stainless steel, plastic, or other appropriate homogenization bucket or bowl
- Ziploc plastic bags
- Logbook
- Labels
- Chain-of-custody forms and seals
- Coolers
- Ice

SOP	1002.04				
GROUP	Sampling Procedures				
SUB-GROUP	Soil Sampling Procedures				
TITLE	Sediment Sampling				
DATE	2/23/2010	FILE	1002-04.DOC	PAGE	2 of 3

- Decontamination supplies and equipment (i.e. brushes and buckets)
- Canvas or plastic sheeting
- Spatulas
- Scoops
- Plastic or stainless steel spoons
- Trowel
- Auger bucket
- Extension rods
- T-handle
- KB Core Sampler
- Ponar Grab Sampler
- Air monitor

Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are required.
2. Obtain necessary sampling and monitoring equipment from the list above. Additional equipment may be added to this list as appropriate to perform other sampling.
3. Decontaminate or preclean equipment, and ensure that it is in working order.
4. Perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.
5. Use stakes, buoys, or flagging to identify and mark all sampling locations. Consider specific site factors, including extent and nature of contaminant, when selecting sample locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and obstructions.

Sediment Sampling in Shallow Waters

The following procedures should be used when collecting sediment samples in shallow waters:

1. Collect sediments as specified in the work plan or as determined during office preparation activities, using a stainless steel trowel, piston corer or similar device and a stainless steel, tempered glass or aluminum container.
2. Standing downstream of the sample stations, collect discrete sediment samples from each station and, if required in the work plan, composite in stainless steel, tempered glass or aluminum container.
3. Collect sediment samples of deposited material from the depth specified in the work plan or as determined during the office preparation activities. Record the depth in the logbook. Selective removal of the top sediment layers may be required and should be accomplished by carefully removing the sediments with a stainless steel trowel or scoop. In streams where water velocity is insufficient to disturb sediment fines during sediment sampling, a stainless

SOP	1002.04				
GROUP	Sampling Procedures				
SUB-GROUP	Soil Sampling Procedures				
TITLE	Sediment Sampling				
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steel trowel or scoop may be used for sampling. Where water velocities are high, a stainless steel corer will be utilized.

4. When applicable, composite discrete sediment samples by placing equal volumes of sediment material collected from the sample points into the container and mixing thoroughly to obtain a homogeneous mixture. Samples may be sieved or hand picked, if necessary, to remove larger materials, such as leaves, sticks, gravel, or rocks. Record in the logbook the nature of any materials removed from the sediment samples.
5. Place each sediment sample into the proper clean, unused sample container, as required by the work plan or laboratory. Sampling personnel must avoid placing sediment into the sample container and decanting off the excess liquid in analyzing for volatile organics and water soluble compounds in the sediment and reduces accurate representation of sediment analysis.
6. Fill out labels with waterproof ink and attach to the sample container.
7. Decontaminate sampling equipment between samples.

Sediment Sampling in Deep Waters

Procedures for sampling in deep waters are the same as for shallow waters except the sampling equipment is different. Soft, fine-grained sediments collected in deep waters will be sampled with a WILDCO KB Core Sampler or similar equipment. Coarse-grained sediments will be collected utilizing a Ponar Grab Sampler or similar equipment. Both samplers will be operated from a boat following appropriate safety procedures. Documentation, containerization, labeling and decontamination procedures are the same as for sediment samples collected in shallow waters.

Sediment Sampling in Drainage Ditches and Intermittent Streams

Procedures for sediment sampling in drainage ditches and the dry portions of intermittent streams are as specified for shallow water sediments.

SOP	1005.01				
GROUP	Sampling Procedures				
SUB-GROUP	Field QA/QC Sampling				
TITLE	Field Duplicate Collection				
DATE	4/27/2005	FILE	1005-01.DOC	PAGE	1 of 2

INTRODUCTION

The following Standard Operating Procedure (SOP) describes the procedure for collecting field duplicate soil and water samples. When samples are collected for analysis, it is typically desired that independent data allowing evaluation of laboratory precision (i.e., the degree to which a laboratory result can be repeated) on site-specific samples be collected.

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field such that they cannot be identified (blind duplicate) as duplicated samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection.

The duplicate soil sampling procedure is closely related to SOP Nos. 1001.01, 1001.03, and 1001.10 regarding soil sampling procedures. This procedure serves as an alternative method or extension of sample preparation prior to placing the samples in containers, as described in the 1001 series of the SOPs (e.g. 1001.01 and 1001.03).

DUPLICATE SOIL SAMPLING PROCEDURE

The procedure to be used to physically collect soil samples are described in SOP Nos. 1001.01 and 1001.03. Reference should be made to these SOPs for specific sampling equipment, procedures, and other general guidelines. As soil is collected, the following procedure will be used to prepare a field duplicate sample:

- The soil will be collected in general accordance with SOP 1001.01 or 1001.03, with the exception that samples will generally not be immediately placed into sample containers and an additional preparation step (i.e., sample splitting) will be performed.
- As they are collected, soil samples to be submitted as field duplicates will be staged in a clean mixing bowl or mixing bucket.
- For samples that will be analyzed for volatile organic compounds, the soil sample will be split in half and an equal portion of soil will be placed directly into two or more different sample containers, each container representing a different sample for laboratory analysis. The soil will not be homogenized to minimize the potential for volatilization of the organic compounds potentially in the sample.
- For analyses of chemicals other than volatile organic compounds, the soil removed from the discrete sample location will be homogenized in a clean mixing bowl using a clean scoop or spatula (as described in SOPs 1001.01 and 1001.03). Homogenization will generally continue until the discrete samples being combined are reasonably indistinguishable as individual samples in the soil mixture. However, it is recognized that homogenization can be difficult for highly plastic clays. In this case, equal amounts of the soil core of each clay sample will be cut into small, roughly cubical pieces using a stainless steel knife and placed into a bowl and homogenized to extent practical.

SOP	1005.01				
GROUP	Sampling Procedures				
SUB-GROUP	Field QA/QC Sampling				
TITLE	Field Duplicate Collection				
DATE	4/27/2005	FILE	1005-01.DOC	PAGE	2 of 2

- The field duplicate sample (except for volatiles as note above) will be collected from the mixing bowl containing the homogenized samples after homogenization is performed. The composited sample will be collected using a stainless steel or disposable plastic scoop or similar tool. The sample will be placed in a clean sample container and then handled in accordance with soil sampling SOPs 1001.01 and 1001.03.

Another difference from the referenced SOPs is that additional soil volume may need to be collected from a discrete sample location during the sampling process to provide sufficient sample volume for two or more sets of laboratory analyses. If the collection of additional sample volume will result in the sample interval expanding to greater depths or laterally outward, the sampling tools identified in 1001 series of the SOPs can be used at two immediately vertically or laterally adjacent locations, as appropriate. If sampling from two adjacent but distinct locations is necessary to obtain adequate sample volume, the soil from the two locations should be composited in accordance with SOP 1001.10. Field duplicates of composited samples may also be performed using this SOP for field duplicate samples.

Variations on this procedure are allowable to accommodate different soil conditions and any site requirements specifically identified in the site-specific Sampling and Analysis Plan. Equipment that may be used as part of the soil compositing procedure is identified under SOP Nos. 1001.01 and 1001.03 where soil sampling methods are described.

DUPLICATE WATER SAMPLING PROCEDURES

The procedure to be used to physically collect water samples are described in 1002 series of the SOPs (e.g. 1002.01 and 1002.02). Reference should be made to these SOPs for specific sampling equipment, procedures, and other general guidelines. A duplicate water sample will be collected from the same location as the parent sample and within 15 minutes of the collection of the parent sample.

The number of samples that may be submitted as blind field duplicates for the project in question will be specified in the site-specific sampling plan. Blind field duplicates are typically collected at a frequency of 1 per 10 samples of a given environmental media at sites, especially where laboratory analytical data will be used for evaluating regulatory compliance and other engineering judgments. Sampling in support of a routine monitoring program may not require field duplicates. Reference should be made to the site-specific contract and work plans.

REFERENCES

SOP No. 1001.01 - Standard Operating Procedure, Surface Soil Sampling
SOP No. 1001.03 - Standard Operating Procedure, Soil Sampling - Hand Auger Method
SOP No. 1001.10 - Standard Operating Procedure, Soil Compositing

SOP	1005.02				
GROUP	Sampling Procedures				
SUB-GROUP	Field QA/QC Sampling				
TITLE	Rinse Blank Preparation				
DATE	2/6/2009	FILE	1005-02.DOC	PAGE	1 of 1

INTRODUCTION

The following Standard Operating Procedure (SOP) presents a method to prepare a type of quality control sample specific to the field decontamination process, the equipment rinse blank. The rinse blank provides information on the effectiveness of the decontamination process employed in the field. When used in conjunction with field blanks and trip blanks, the rinse blank can be used to assist in evaluating possible compromise of samples from field related activities.

PROCEDURE

The equipment rinse blank is prepared by passing target analyte-free (i.e., deionized) water over and through a field decontaminated sampling device, then collecting the rinse water in appropriate clean sample containers. Rinse blanks will typically be collected from equipment that comes in contact with samples, such as auger buckets, split spoons, bailers, shelby tubes, and stainless steel spoons/trowels. The collected sample will be coded appropriately prior to logging and shipping. Equipment blanks are not required if dedicated sampling equipment is used. Equipment blanks will be collected periodically during the day immediately after decontamination of the sampling equipment being used.

The frequency for collecting equipment blanks will be determined prior to engaging in field activities, and communicated in site-specific quality assurance project plans, sampling and analyses plans, or a type of work plan. Equipment blanks will be collected at a rate relative to each type of sample collection procedure (i.e., surface sample, sample at depth using a hand auger). Equipment blanks will generally be collected at a frequency of 1 per 20 (normal) samples of a given matrix.

SOP	1101.01				
GROUP	Sampling Handling				
SUB-GROUP	Sample Custody				
TITLE	Sample Custody in the Field				
DATE	11/19/2001	FILE	1101-01.DOC	PAGE	1 of 4

INTRODUCTION

The following Standard Operating Procedure (SOP) presents procedures for maintaining sample chain of custody (COC) during activities where samples are collected.

PROCEDURE

Sample custody is defined as being under a person's custody if any of the following conditions exist:

- it is in their possession,
- it is in their view, after being in their possession,
- it was in their possession and they locked it up, or
- it is in a designated secure area.

A designated field sampler will be personally responsible for the care and custody of collected samples until they are transferred to another person or properly dispatched to the laboratory. To the extent practicable, as few people as possible will handle the samples.

Sample tags or labels will be completed and applied to the container of each sample. When the tags or labels are being completed, waterproof ink will be used. If waterproof ink is not used, the tags or labels will be covered by transparent waterproof tape. Sample containers may also be placed in Ziploc-type storage bags to help keep them clean in the cooler. Information typically included on the sample tags or labels will include the following:

- Project Code
- Station Number and Location
- Sample Identification Number
- Date and Time of Sample Collection
- Type of Laboratory Analysis Required
- Preservation Required, if applicable
- Collector's Signature
- Priority (optional)
- Other Remarks

Additional information may include:

- Anticipated Range of Results (Low, Medium, or High)
- Sample Analysis Priority

SOP	1101.01				
GROUP	Sampling Handling				
SUB-GROUP	Sample Custody				
TITLE	Sample Custody in the Field				
DATE	11/19/2001	FILE	1101-01.DOC	PAGE	2 of 4

A COC form will be completed each time a sample or group of samples is prepared for transfer to the laboratory. The form will repeat the information on each of the sample labels and will serve as documentation of handling during shipment. The minimum information requirements of the COC form are listed in Table 1101.01-A. An example COC form is shown in Figure 1101.01-A. The completed COC must be reviewed by the Field Team Leader or Site Manager prior to sample shipment. The COC form will remain each sample shipping container at all times, and another copy will be retained by the member of the sampling team who originally relinquished the samples or in a project file.

SOP	1101.01				
GROUP	Sampling Handling				
SUB-GROUP	Sample Custody				
TITLE	Sample Custody in the Field				
DATE	11/19/2001	FILE	1101-01.DOC	PAGE	3 of 4

TABLE 1101.01-A CHAIN OF CUSTODY FORM

INFORMATION	COMPLETED BY	DESCRIPTION
COC	Laboratory	enter a unique number for each chain of custody form
SHIP TO	Field Team	enter the laboratory name and address
CARRIER	Field Team	enter the name of the transporter (e.g., FedEx) or handcarried
AIRBILL	Field Team	enter the airbill number or transporter tracking number (if applicable)
PROJECT NAME	Field Team	enter the project name
SAMPLER NAME	Field Team	enter the name of the person collecting the samples
SAMPLER SIGNATURE	Field Team	signature of the person collecting the samples
SEND RESULTS TO	Field Team	enter the name and address of the prime contractor
FIELD SAMPLE ID	Field Team	enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)
DATE	Field Team	enter the year and date the sample was collected in the format M/D (e.g., 6/3)
TIME	Field Team	enter the time the sample was collected in 24 hour format (e.g., 0900)
MATRIX	Field Team	enter the sample matrix (e.g., water, soil)
PRESERVATIVE	Field Team	enter the preservative used (e.g., HNO3) or "none"
FILTERED/ UNFILTERED	Field Team	enter "F" if the sample was filtered or "U" if the sample was not filtered
CONTAINERS	Field Team	enter the number of containers associated with the sample
MS/MSD	Field Team or Laboratory	enter "X" if the sample is designated for the MS/MSD
ANALYSES REQUESTED	Field Team	enter the method name of the analysis requested (e.g., SW6010A)
COMMENTS	Field Team	enter comments
SAMPLE CONDITION UPON RECEIPT AT LABORATORY	Laboratory	enter any problems with the condition of any sample(s)
COOLER TEMPERATURE	Laboratory	enter the internal temperature of the cooler, in degrees C, upon opening
SPECIAL INSTRUCTIONS/COMMENTS	Laboratory	enter any special instructions or comments
RELEASED BY (SIG)	Field Team and Laboratory	enter the signature of the person releasing custody of the samples
COMPANY NAME	Field Team and Laboratory	enter the company name employing the person releasing/receiving custody
RECEIVED BY (SIG)	Field Team and Laboratory	enter the signature of the person receiving custody of the samples
DATE	Field Team and Laboratory	enter the date in the format M/D/YY (e.g., 6/3/96) when the samples were released/received
TIME	Field Team and Laboratory	enter the date in 24 hour format (e.g., 0900) when the samples were released/received

SOP	1101.01				
GROUP	Sampling Handling				
SUB-GROUP	Sample Custody				
TITLE	Sample Custody in the Field				
DATE	11/19/2001	FILE	1101-01.DOC	PAGE	4 of 4

FIGURE 1101.01-A CHAIN OF CUSTODY FORM

SOP	1102.01				
GROUP	Sample Handling				
SUB-GROUP	Sample Shipping				
TITLE	Sample Shipping				
DATE	11/19/2001	FILE	1102-01.DOC	PAGE	1 of 1

INTRODUCTION

The following Standard Operating Procedure (SOP) presents the procedures for sample shipping that will be implemented during field work involving sampling activities.

TERMS

COC - Chain-of-Custody

PROCEDURE

Prior to shipping or transferring custody of samples, they will be packed according to D.O.T. requirements with sufficient ice to maintain an internal temperature of $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$ during transport to the laboratory. Samples relinquished to the participating laboratories will be subject to the following procedures for transfer of custody and shipment:

1. Samples will be accompanied by a COC record. When transferring possession of samples, the individuals relinquishing and receiving the samples will sign, date, and note the time of the sample transfer on the record. If sent by common carrier, a bill of lading or airbill should be used. Bill of lading and airbill receipts will be retained in the project file as part of the permanent documentation of sample shipping and transfer. This custody record documents transfer of sample custody from the sampler to another person or to the laboratory. The designated laboratory will accept custody in the field upon sample pick-up or at the laboratory if the samples are delivered via field personnel or a courier service.
2. Samples will be properly packed in approved shipping containers for laboratory pick-up by the appropriate laboratory for analysis, with separate, signed custody records enclosed in each sample box or cooler. Sample shipping containers will be padlocked or custody-sealed for transfer to the laboratory. The preferred procedure includes use of a custody seal wrapped across filament tape that is wrapped around the package at least twice. The custody seal will then be folded over and stuck to itself so that the only access to the package is by cutting the filament tape or breaking the seal to unwrap the tape. The seal will then be signed. The designated laboratory will accept custody of the samples upon receipt.
3. Whenever samples are split with state representatives or other parties, the COC record will be marked to indicate with whom the samples were split.
4. The field sampler will call the designated laboratory to inform them of sample shipment and verify sample receipt as necessary.

SOP	1201.01				
GROUP	Decontamination				
SUB-GROUP	Sampling Equipment Decontamination				
TITLE	Sampling Equipment Decontamination				
DATE	11/19/2001	FILE	1201-01.DOC	PAGE	1 of 3

INTRODUCTION

The following Standard Operating Procedure (SOP) presents the methods used for minimizing the potential for cross-contamination, and provides general guidelines for sampling equipment decontamination procedures.

PROCEDURE

As part of the Health and Safety Plan (HASP), develop and set up a decontamination plan before any personnel or equipment enter the areas of potential exposure. The decontamination plan should include the following:

- The number, location, and layout of decontamination stations
- Which decontamination apparatus is needed
- The appropriate decontamination methods
- Methods for disposal of contaminated clothing, apparatus, and solutions

Decontamination Methods

Personnel, samples, and equipment leaving the contaminated area of a site will be decontaminated. Various decontamination methods will be used to either physically remove contaminants, inactivate contaminants by disinfection or sterilization, or both. The physical decontamination techniques appropriate for equipment decontamination can be grouped into two categories: abrasive methods and non-abrasive methods.

Abrasive Cleaning Methods

Abrasive cleaning methods work by rubbing/scrubbing the surface containing the contaminant. This method includes mechanical and wet blasting methods.

Mechanical cleaning methods use brushes of metal or nylon. The amount and type of contaminants removed will vary with the hardness of bristles, length of brushing time, and degree of brush contact.

Cleaning can also be accomplished by water blasting which is also referred to as steam cleaning and pressure washing. Pressure washing utilizes high-pressure that is sprayed from a nozzle onto sampling equipment to physically remove soil or (potentially) contaminated material. Steam cleaning is a modification of pressure washing where the water is heated to temperatures approaching 100°C to assist in removing organic constituents from equipment.

SOP	1201.01				
GROUP	Decontamination				
SUB-GROUP	Sampling Equipment Decontamination				
TITLE	Sampling Equipment Decontamination				
DATE	11/19/2001	FILE	1201-01.DOC	PAGE	2 of 3

Disinfection/Rinse Methods

Disinfectants are a practical means of inactivating chemicals or contaminants of concern. Standard sterilization methods involve heating the equipment which is impractical for large equipment. Rinsing removes contaminants through dilution, physical attraction, and solubilization.

The use of distilled/deionized water commonly available from commercial vendors may be acceptable for decontamination of sampling equipment provided that it has been verified by laboratory analysis to be target analyte free. Tap water may be used from any municipal water treatment system for mixing of decontamination solutions. An untreated potable water supply is not an acceptable substitute for tap water. Acids and solvents are occasionally utilized in decontamination of equipment to remove metals and organics, respectively, from sampling equipment. Other than ethanol, these are avoided when possible due to the safety, disposal, and transportation concerns associated with them.

Equipment or apparatuses that may be selected for use include the following:

- Personal protective clothing
- Non-phosphate detergent
- Selected solvents for removal of polar and nonpolar organics (ethanol, methanol, hexane)
- Acid washes for removal of metals (nitric acid)
- Long-handled brushes
- Drop cloths or plastic sheeting
- Paper towels
- Galvanized tubs or buckets
- Distilled, deionized, or tap water (as required by the project)
- Storage containers for spent wash solutions
- Sprayers (pressurized and non-pressurized)
- Trash bags
- Safety glasses or splash shield

Field Sampling Equipment Cleaning Procedures

The following procedures should be followed:

1. Where applicable, follow physical removal procedures previously described (pressure wash, scrub wash)
2. Wash equipment with a non-phosphate detergent solution
3. Rinse with tap water
4. Rinse with distilled or deionized water
5. Rinse with 10% nitric acid if the sample will be analyzed for metals/organics
6. Rinse with distilled or deionized water
7. Use a solvent rinse (pesticide grade) if the sample will be analyzed for organics
8. Air dry the equipment completely
9. Rinse again with distilled or deionized water

SOP	1201.01				
GROUP	Decontamination				
SUB-GROUP	Sampling Equipment Decontamination				
TITLE	Sampling Equipment Decontamination				
DATE	11/19/2001	FILE	1201-01.DOC	PAGE	3 of 3

10. Place in clean bag or container for storage/transport to subsequent sampling locations.

Selection of the solvent for use in the decontamination process is based on the contaminants present at the site. Solvent rinses are not necessarily required when organics are not a contaminant of concern and may be eliminated from the sequence specified below. Similarly, an acid rinse is not required if the analyses do not include inorganics. Use of a solvent is required when organic contamination is present on-site. Typical solvents used for removal of organic contaminants include acetone, ethanol, hexane, methanol, or water. An acid rinse step is required if metals are present on-site. If a particular contaminant fraction is not present at the site, the ten-step decontamination procedure listed above may be modified for site specificity.

Sampling equipment that requires the use of plastic tubing should be disassembled and the tubing replaced with clean tubing before commencement of sampling and between sampling locations. Plastic tubing should not be reused.

SOP	1501.01				
GROUP	Field Documentation				
SUB-GROUP					
TITLE	Field Logbook				
DATE	11/19/2001	FILE	1501-01.DOC	PAGE	1 of 3

INTRODUCTION

The following Standard Operating Procedure (SOP) presents the procedures for documenting activities observed or completed in the field in a field logbook. The documentation should represent all activities of WESTON personnel and entities under WESTON's supervision.

TERMS

FSP - Field Sampling Plan

SAP - Sampling and Analysis Plan

QAPP - Quality Assurance Project Plan

HASP - Health and Safety Plan

PROCEDURE

Field logbooks will be used and maintained during field activities to document pertinent information observed or completed by WESTON personnel or entities that WESTON is responsible for providing oversight. Field logbooks are legal documents that form the basis for later written reports and may serve as evidence in legal proceedings. The Site Manager or Field Team Leader will review field log entries daily and initial each page of entries. Field logbooks will be maintained by the Site Manager or Field Team Leader during field activities and transferred to the project files for a record of activities at the conclusion of the project. General logbook entry procedures are listed below.

- Logbooks must be permanently bound with all pages numbered to the end of the book. Entries should begin on page 1.
- Only use blue or black ink (waterproof) for logbook entries.
- Sign entries at the end of the day, or before someone else writes in the logbook.
- If a complete page is not used, draw a line diagonally across the blank portion of the page and initial and date the bottom line.
- If a line on the page is not completely filled, draw a horizontal line through the blank portion.
- Ensure that the logbook clearly shows the sequence of the day's events.
- Do not write in the margins or between written lines, and do not leave blank pages to fill in later.
- If an error is made, make corrections by drawing a single line through the error and initialing it.
- Maintain control of the logbook and keep in a secure location.

SOP	1501.01				
GROUP	Field Documentation				
SUB-GROUP					
TITLE	Field Logbook				
DATE	11/19/2001	FILE	1501-01.DOC	PAGE	2 of 3

Field logbooks will contain, at a minimum, the following information, if applicable:

General Information

- Name, location of site, and work order number
- Name of the Site Manager or Field Team Leader
- Names and responsibilities of all field team members using the logbook (or involved with activities for which entries are being made)
- Weather conditions
- Field observations
- Names of any site visitors including entities that they represent

Sample Collection Activities

- Date(s) and times of the sample collection or event.
- Number and types of collected samples.
- Sample location with an emphasis on any changes to documentation in governing documents (i.e., SAP, FSP). This may include measurements from reference points or sketches of sample locations with respect to local features.
- Sample identification numbers, including any applicable cross-references to split samples or samples collected by another entity.
- A description of sampling methodology, or reference to any governing document (i.e., FSP, SAP, QAPP).
- Summary of equipment preparation and decontamination procedures.
- Sample description including depth, color, texture, moisture content, and evidence of waste material or staining.
- Air monitoring (field screening) results.
- Types of laboratory analyses requested.

Site Health and Safety Activities

- All safety, accident, and/or incident reports.

SOP	1501.01				
GROUP	Field Documentation				
SUB-GROUP					
TITLE	Field Logbook				
DATE	11/19/2001	FILE	1501-01.DOC	PAGE	3 of 3

- Real-time personnel air monitoring results, if applicable, or if not documented in the HASP.
- Heat/cold stress monitoring data, if applicable.
- Reasons for upgrades or downgrades in personal protective equipment.
- Health and safety inspections, checklists (drilling safety guide), meetings/briefings.
- Calibration records for field instruments.

Oversight Activities

- Progress and activities performed by contractors including operating times.
- Deviations of contractor activities with respect to project governing documents (i.e., specifications).
- Contractor sampling results and disposition of contingent soil materials/stockpiles.
- Excavation specifications and locations of contractor confirmation samples.
- General site housekeeping and safety issues by site contractors.

SOP	1502.01				
GROUP	Field Documentation				
SUB-GROUP					
TITLE	Photograph Logs				
DATE	11/19/2001	FILE	1502-01.DOC	PAGE	1 of 1

INTRODUCTION

The following Standard Operating Procedure (SOP) presents the requirements for collecting information related to photodocumentation of site activities.

PROCEDURE

- Uniquely number each roll of film obtained for use.
- Record the following information for each negative exposed:
 1. Date and Time
 2. Photographer Name
 3. Witness Name
 4. Orientation (Landscape, Portrait, or Panaoramic)
 5. Description (including activity being performed, specific equipment of interest, sample location(s), compass direction photographer is facing)
- Record "NA" for the negatives not used if the roll is not completely used prior to development.
- Record unique roll number on receipt when film is submitted for development.
- Verify descriptions on log with negative numbers when photographs are received from processing.

FORMS

Blank Photograph Logs can be printed from WESTON On-Line from the *Records Management Application*. Selecting the *Reports/Project Planning/Blank Photo Logs* menu option will generate a project specific log with 36 entries.

SOP	0110.01				
GROUP	Database Management System				
SUB-GROUP	Data Collection and Acquisition				
TITLE	Sample Nomenclature				
DATE	02/26/2009	FILE	0110-20060227.DOC	PAGE	1 of 2

INTRODUCTION

The following Standard Operating Procedure (SOP) presents the sample nomenclature for analytical samples that will generate unique sample names compatible with most data management systems. The sample nomenclature is based upon specific requirements for the reporting of these results. A site specific data management plan should be prepared prior to sample collection.

PROCEDURE

SAMPLE NOMENCLATURE – SOIL AND SEDIMENT

Area of Concern – ID – Depth - Collection Type + QC Type

Where:

Area of Concern: A four-digit identifier used to designate the particular Area of Concern (AOC) that the location where the sample was collected.

ID: A three-digit identifier used to designate the particular location in the AOC from which the sample was collected or the center of the composite sample.

Depth: A two-digit code used to designate what depth of sample was collected:

03	0 to 3 inches
06	3 to 6 inches
12	6 to 12 inches

Collection Type: A one-digit code used to designate what type of sample was collected:

1	Surface Water
2	Ground Water
3	Leachate
4	Field QC/water sample
5	Soil/Sediment

6	Oil
7	Waste
8	Other
9	Drinking Water

QC Type: A one-digit code used to designate the QC type of the sample:

1	Normal
2	Duplicate
3	Rinsate Blank
4	Trip Blank
5	Field Blank
6	Confirmation

Examples:

- **2054-055-06-51:** Represents the normal soil sample collected from AOC 2054 at location 055 from 3 to 6 inches of depth.
- **2054-055-06-52:** Represents the duplicate soil sample collected from AOC 2054 at location 055 from 3 to 6 inches of depth.
- **2054-055-06-43:** Represents the rinsate water sample collected after the last sample of the day if last sample was collected from AOC 2054 at location 055 from 3 to 6 inches of depth.

SOP	0110.01				
GROUP	Database Management System				
SUB-GROUP	Data Collection and Acquisition				
TITLE	Sample Nomenclature				
DATE	02/26/2009	FILE	0110-20060227.DOC	PAGE	2 of 2

SAMPLE NOMENCLATURE – WATER (from fixed station or location to be sampled more than once)

WELL OR STATION – YYYYMMDD - Collection Type + QC Type

Where:

Well or Station: For Wells and boreholes always assume there will be 10 or more so Monitoring Well 1 becomes designated MW01 or MW-01. If it is anticipated that there will be over 100 wells designate Monitoring Well 1 as MW001 or MW-001.

YYYYMMDD: A four-digit year + two-digit month + two-digit day

Collection Type: A one-digit code used to designate what type of sample was collected and are shown on page 1.

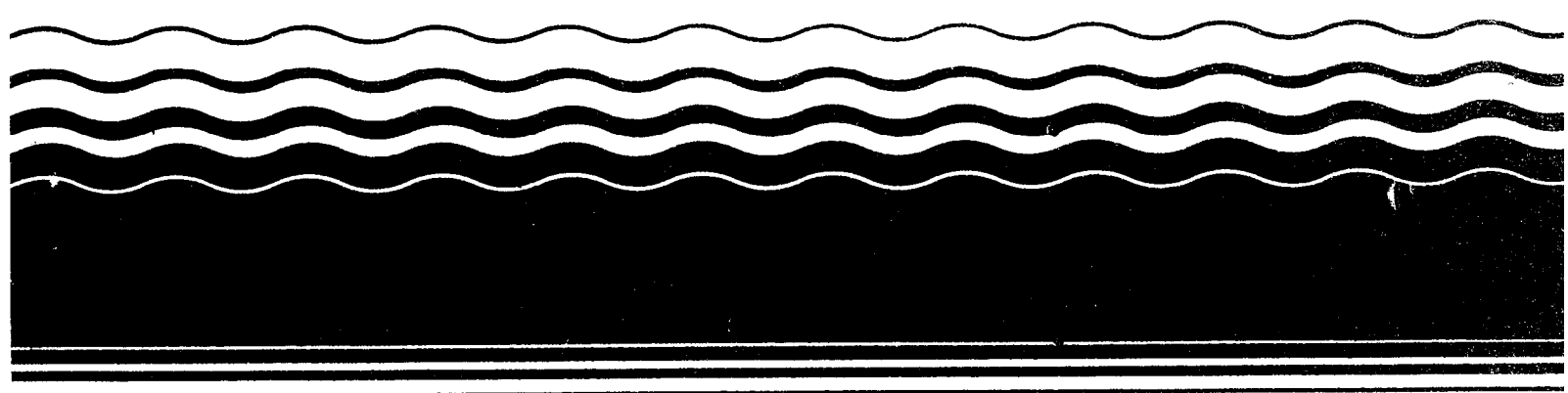
QC Type: A one-digit code used to designate the QC type of the sample and are shown on page 1.

Examples:

- **MW01-20090226-21:** Represents the normal groundwater sample collected from Monitoring Well 1 on 26 February 2009.
- **MW01-20090226-44:** Represents the trip blank in the same ice chest as the groundwater sample in the previous collected from Monitor Well 1 on 02/26/2009. All trip blanks must have a sample ID and they must be unique and on the Chain-of-Custody.
- **2054-000-00-43:** Represents the rinsate sample from AOC 2054



Compendium of ERT Groundwater Sampling Procedures



COMPENDIUM OF ERT GROUNDWATER SAMPLING PROCEDURES

Sampling Equipment Decontamination

Groundwater Well Sampling

Soil Gas Sampling

Monitoring Well Installation

Water Level Measurement

Well Development

Controlled Pumping Test

Slug Test

Interim Final

Environmental Response Team
Emergency Response Division

Office of Emergency and Remedial Response
U.S. Environmental Protection Agency
Washington, DC 20460



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Notice

This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

The policies and procedures established in this document are intended solely for the guidance of government personnel, for use in the Superfund Removal Program. They are not intended, and cannot be relied upon, to create any rights, substantive or procedural, enforceable by any party in litigation with the United States. The Agency reserves the right to act at variance with these policies and procedures and to change them at any time without public notice.

Depending on circumstances and needs, it may not be possible or appropriate to follow these procedures exactly in all situations due to site conditions, equipment limitations, and limitations of the standard procedures. Whenever these procedures cannot be followed as written, they may be used as general guidance with any and all modifications fully documented in either QA Plans, Sampling Plans, or final reports of results.

Each Standard Operating Procedure in this compendium contains a discussion on quality assurance/quality control (QA/QC). For more information on QA/QC objectives and requirements, refer to the *Quality Assurance/Quality Control Guidance for Removal Activities*, OSWER directive 9360.4-01, EPA/540/G-90/004.

Questions, comments, and recommendations are welcomed regarding the Compendium of ERT Groundwater Sampling Procedures. Send remarks to:

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1.0 SAMPLING EQUIPMENT DECONTAMINATION: SOP #2006

1.1 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) describes methods used for preventing or reducing cross-contamination, and provides general guidelines for sampling equipment decontamination procedures at a hazardous waste site. Preventing or minimizing cross-contamination in sampled media and in samples is important for preventing the introduction of error into sampling results and for protecting the health and safety of site personnel.

Removing or neutralizing contaminants that have accumulated on sampling equipment ensures protection of personnel from permeating substances, reduces or eliminates transfer of contaminants to clean areas, prevents the mixing of incompatible substances, and minimizes the likelihood of sample cross-contamination.

1.2 METHOD SUMMARY

Contaminants can be physically removed from equipment, or deactivated by sterilization or disinfection. Gross contamination of equipment requires physical decontamination, including abrasive and non-abrasive methods. These include the use of brushes, air and wet blasting, and high-pressure water cleaning, followed by a wash/rinse process using appropriate cleaning solutions. Use of a solvent rinse is required when organic contamination is present.

1.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

This section is not applicable to this SOP.

1.4 INTERFERENCES AND POTENTIAL PROBLEMS

- ◀◀ The use of distilled/deionized water commonly available from commercial vendors may be acceptable for decontamination of sampling equipment

provided that it has been verified by laboratory analysis to be analyte free.

- ◀ An untreated potable water supply is not an acceptable substitute for tap water. Tap water may be used from any municipal water treatment system for mixing of decontamination solutions.
- Acids and solvents utilized in the decontamination sequence pose the health and safety risks of inhalation or skin contact, and raise shipping concerns of permeation or degradation.
- The site work plan must address disposal of the spent decontamination solutions.
- Several procedures can be established to minimize contact with waste and the potential for contamination. For example:

Stress work practices that minimize contact with hazardous substances.

Use remote sampling, handling, and container-opening techniques when appropriate.

Cover monitoring and sampling equipment with protective material to minimize contamination.

Use disposable outer garments and disposable sampling equipment when appropriate.

1.5 EQUIPMENT/APPARATUS

- appropriate personal protective clothing
- non-phosphate detergent
- selected solvents
- long-handled brushes
- drop cloths/plastic sheeting
- trash container
- paper towels
- galvanized tubs or buckets
- tap water

- distilled/deionized water
- metal/plastic containers for storage and disposal of contaminated wash solutions
- pressurized sprayers for tap and deionized/distilled water
- sprayers for solvents
- trash bags
- aluminum foil
- safety glasses or splash shield
- emergency eyewash bottle

1.6 REAGENTS

There are no reagents used in this procedure aside from the actual decontamination solutions and solvents. In general, the following solvents are utilized for decontamination purposes:

- ☞ 10% nitric acid⁽¹⁾
- ☞ acetone (pesticide grade)(*)
- ☞ hexane (pesticide grade)(*)
- ☞ methanol

- (¹) Only if sample is to be analyzed for trace metals.
 (2) Only if sample is to be analyzed for organics.

1.7 PROCEDURES

As part of the health and safety plan, develop and set up a decontamination plan before any personnel or equipment enter the areas of potential exposure. The equipment decontamination plan should include:

- ☞ the number, location, and layout of decontamination stations
- ☞ which decontamination apparatus is needed
- the appropriate decontamination methods
- methods for disposal of contaminated clothing, apparatus, and solutions

1.7.1 Decontamination Methods

All personnel, samples, and equipment leaving the contaminated area of a silt must be decontaminated. Various decontamination methods will either physically remove contaminants, inactivate contaminants by disinfection or sterilization, or do hot h.

In many cases, gross contamination can be removed by physical means. The physical decontamination techniques appropriate for equipment decontamination can be grouped into two categories: abrasive methods and non-abrasive methods.

Abrasive Cleaning Methods

Abrasive cleaning methods work by rubbing and wearing away the top layer of the surface containing the contaminant. The following abrasive methods are available:

- ☞ Mechanical: Mechanical cleaning methods use brushes of metal or nylon. The amount and type of contaminants removed will vary with the hardness of bristles, length of brushing time, and degree of brush contact.
- ☞ Air Blasting: Air blasting is used for cleaning large equipment, such as bulldozers, drilling rigs or auger bits. The equipment used in air blast cleaning employs compressed air to force abrasive material through a nozzle at high velocities. The distance between the nozzle and the surface cleaned, as well as the pressure of air, the time of application, and the angle at which the abrasive strikes the surface, determines cleaning efficiency. Air blasting has several disadvantages: it is unable to control the amount of material removed, it can create contaminants, and it generates large amounts of waste.
- Wet Blasting: Wet blast cleaning, also used to clean large equipment, involves use of a suspended fine abrasive: delivered by compressed air to the contaminated area. The amount of materials removed can be carefully controlled by using wry line abrasives. This method generates a large amount of waste.

Non-Abrasive Cleaning Methods

Non-abrasive cleaning methods work by forcing the contaminant off of a surface with pressure. In general, less of the equipment surface is removed using non-abrasive methods. The following non-abrasive methods are available:

☞ **High-Pressure Water:** This method consists of a high-pressure pump, an operator-controlled directional nozzle, and a high pressure hose. Operating pressure usually ranges from 340 to 680 atmospheres (atm) which relates to flow rates of 20 to 140 liters per minute.

☞ **Ultra-High-Pressure Water:** This system produces a pressurized water jet (from 1,000 to 4,000 atm). The ultra-high-pressure spray removes tightly-adhered surface film. The water velocity ranges from 500 m/sec (1,000 atm) to 900 m/sec (4,000 atm). Additives can enhance the method. This method is not applicable for hand-held sampling equipment.

Disinfection/Rinse Methods

☞ **Disinfection:** Disinfectants are a practical means of inactivating infectious agents.

☞ **Sterilization:** Standard sterilization methods involve heating the equipment. Sterilization is impractical for large equipment.

☞ **Rinsing:** Rinsing removes contaminants through dilution, physical attraction, and solubilization.

1.7.2 Field Sampling Equipment Cleaning Procedures

Solvent rinses are not necessarily required when organics are not a contaminant of concern and may be eliminated from the sequence specified below. Similarly, an acid rinse is not required if analysis does not include inorganics.

1. Where applicable, follow physical removal procedures specified in section 1.7.1.
2. Wash equipment with a non-phosphate detergent solution.
3. Rinse with tap water.
4. Rinse with distilled/deionized water.
5. Rinse with 10% nitric acid if the sample will be analyzed for trace organics.

6. Rinse with distilled/deionized water.

7. Use a solvent rinse (pesticide grade) if the sample will be analyzed for organics.

8. Air dry the equipment completely.

9. Rinse again with distilled/deionized water.

Selection of the solvent for use in the decontamination process is based on the contaminants present at the site. Use of a solvent is required when organic contamination is present on-site. Typical solvents used for removal of organic contaminants include acetone, hexane, or water. An acid rinse step is required if metals are present on-site. If a particular contaminant fraction is not present at the site, the nine-step decontamination procedure listed above may be modified for site specificity. The decontamination solvent used should not be among the contaminants of concern at the site.

Table 1 lists solvent rinses which may be required for elimination of particular chemicals. After each solvent rinse, the equipment should be air dried and rinsed with distilled/deionized water.

Sampling equipment that requires the use of plastic tubing should be disassembled and the tubing replaced with clean tubing, before commencement of sampling and between sampling locations.

1.8 CALCULATIONS

This section is not applicable to this SOP.

1.9 QUALITY ASSURANCE/ QUALITY CONTROL

One type of quality control sample specific to the field decontamination process is the rinsate blank. The rinsate blank provides information on the effectiveness of the decontamination process employed in the field. When used in conjunction with field blanks and trip blanks, a rinsate blank can detect contamination during sample handling, storage and sample transportation to the laboratory.

Table 1: Recommended Solvent Rinse for Soluble Contaminants

SOLVENT	SOLUBLE CONTAMINANTS
Water	<ul style="list-style-type: none"> /// Low-chain hydrocarbons /// Inorganic compounds • Salts ✓ Some organic acids and other polar compounds
Dilute Acids	<ul style="list-style-type: none"> /// Basic (caustic) compounds /// Amines /// Hydrazines
Dilute Bases -- for example, detergent and soap	<ul style="list-style-type: none"> /// Metals • Acidic compounds /// Phenol ✓ Thiols ✓ Some nitro and sulfonic compounds
Organic Solvents ⁽¹⁾ - for example, alcohols, ethers, ketones, aromatics, straight-chain alkanes (e.g., hexane), and common petroleum products (e.g., fuel, oil, kerosene)	<ul style="list-style-type: none"> ✓ Nonpolar compounds (e.g., some organic compounds)

⁽¹⁾ - WARNING: Some organic solvents can permeate and/or degrade protective clothing.

A rinsate blank consists of a sample of analyte-free (i.e, deionized) water which is passed over and through a field decontaminated sampling device and placed in a clean sample container.

Rinsate blanks should be run for all parameters of interest at a rate of 1 per 20 for each parameter, even if samples are not shipped that day. Rinsate blanks are not required if dedicated sampling equipment is used.

1.10 DATA VALIDATION

This section is not applicable to this SOP.

1.11 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA and specific health and safety procedures.

Decontamination can pose hazards under certain circumstances even though performed to protect

health and safety. Hazardous substances may be incompatible with decontamination methods. For example, the decontamination solution or solvent may react with contaminants to produce heat, explosion, or toxic products. Decontamination methods may be incompatible with clothing or equipment; some solvents can permeate or degrade protective clothing. Also, decontamination solutions and solvents may pose a direct health hazard to workers through inhalation or skin contact, or if they combust.

The decontamination solutions and solvents must be determined to be compatible before use. Any method that permeates, degrades, or damages personal protective equipment should not be used. If decontamination methods pose a direct health hazard, measures should be taken to protect personnel or the methods should be modified to eliminate the hazard.

2.0 GROUNDWATER WELL SAMPLING: SOP #2007

2.1 SCOPE AND APPLICATION

The objective of this Standard Operating Procedure (SOP) is to provide general reference information on sampling of groundwater wells. This guideline is primarily concerned with the collection of water samples from the saturated zone of the subsurface. Every effort must be made to ensure that the sample is representative of the particular zone of water being sampled. These procedures are designed to be used in conjunction with analyses for the most common types of groundwater contaminants (e.g., volatile and semi-volatile organic compounds, pesticides, metals, biological parameters).

2.2 METHOD SUMMARY

Prior to sampling a monitoring well, the well must be purged. This may be done with a number of instruments. The most common of these are the bailer, submersible pump, non-gas contact bladder pump and inertia pump. At a minimum, three well volumes should be purged, if possible. Equipment must be decontaminated prior to use and between wells. Once purging is completed and the correct laboratory-cleaned sample containers have been prepared, sampling may proceed. Sampling may be conducted with any of the above instruments, and need not be the same as the device used for purging. Care should be taken when choosing the sampling device as some will affect the integrity of the sample. Sampling equipment must also be decontaminated. Sampling should occur in a progression from the least to most contaminated well, if this information is known.

2.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The type of analysis for which a sample is being collected determines the type of bottle, preservative, holding time, and filtering requirements. Samples should be collected directly from the sampling device into appropriate laboratory-cleaned containers. Check that a Teflon liner is present in

the cap, if required. Attach a sample identification label. Complete a field data sheet, a chain of custody form and record all pertinent data in the site logbook.

Samples shall be appropriately preserved, labelled, logged, and placed in a cooler to be maintained at 4°C. Samples must be shipped well before the holding time is over and ideally should be shipped within 24 hours of sample collection. It is imperative that these samples be shipped or delivered daily to the analytical laboratory in order to maximize the time available for the laboratory to perform the analysis. The bottles should be shipped with adequate packing and cooling to ensure that they arrive intact.

Certain conditions may require special handling techniques. For example, treatment of a sample for volatile organic (WA) analysis with sodium thiosulfate preservative is required if there is residual chlorine in the water (such as public water supply) that could cause free radical chlorination and change the identity of the original contaminants. However, sodium thiosulfate should not be used if chlorine is not present in the water. Special requirements must be determined prior to conducting fieldwork.

2.4 INTERFERENCES AND POTENTIAL PROBLEMS

2.4.1 General

The primary goal of groundwater sampling is to obtain a representative sample of the groundwater body. Analysis can be compromised by field personnel in two primary ways: (1) taking an unrepresentative sample, or (2) by incorrect handling of the sample. There are numerous ways of introducing foreign contaminants into a sample, and these must be avoided by following strict sampling procedures and only utilizing trained field personnel.

2.4.2 Purging

In a non-pumping well, there will be little or no vertical mixing of the water, and stratification will

occur. The well water in the screened section will mix with the groundwater due to normal flow patterns, but the well water above the screened section will remain isolated, become stagnant and lack the VOAs representative of the groundwater. Sampling personnel should realize that stagnant water may contain foreign material inadvertently or deliberately introduced from the surface, resulting in an unrepresentative sample. To safeguard against collecting nonrepresentative stagnant water, follow these guidelines during sampling:

- ☞ As a general rule, all monitoring wells should be pumped or bailed prior to sampling. Purge water should be containerized on site or handled as specified in the site-specific project plan. Evacuation of a minimum of one volume of water in the well casing, and preferably three to five volumes, is recommended for a representative sample. In a high-yielding ground water formation and where there is no stagnant water in the well above the screened section, evacuation prior to sample withdrawal is not as critical. However, in all cases where the monitoring data is to be used for enforcement actions, evacuation is recommended.
- ☞ For wells that can be pumped or bailed to dryness with the equipment being used, the well should be evacuated and allowed to recover prior to sample withdrawal. If the recovery rate is fairly rapid and the schedule allows, evacuation of more than one volume of water is preferred. If recovery is slow, sample the well upon recovery after one evacuation.
- ☞ A nonrepresentative sample can also result from excessive pre-pumping of the monitoring well. Stratification of the leachate concentration in the groundwater formation may occur, or heavier-than-water compounds may sink to the lower portions of the aquifer. Excessive pumping can dilute or increase the contaminant concentrations from what is representative of the sampling point of interest.

2.4.3 Materials

Samplers and evacuation equipment (bladders, pumps, bailers, tubing, etc.) should be limited to

those made with stainless steel, Teflon, and glass in areas where concentrations are expected to be at or near the detection limit. The tendency of organics to leach into and out of many materials make the selection of materials critical for trace analyses. The use of plastics, such as PVC or polyethylene, should be avoided when analyzing for organics. However, PVC may be used for evacuation equipment as it will not come in contact with the sample.

Table 2 on page 7 discusses the advantages and disadvantages of certain equipment.

2.5 EQUIPMENT/APPARATUS

2.5.1 General

- water level indicator
 - electric sounder
 - steel tape
 - transducer
 - reflection sounder
 - airline
- depth sounder
- appropriate keys for well cap locks
- steel brush
- HNU or OVA (whichever is most appropriate)
- logbook
- calculator
- field data sheets
- chain of custody forms
- forms and seals
- sample containers
- Engineer's rule
- sharp knife (locking blade)
- tool box (to include at least: screwdrivers, pliers, hacksaw, hammer, flashlight, adjustable wrench)
- leather work gloves
- appropriate health and safety gear
- 5-gallon pail
- plastic sheeting
- shipping containers
- packing materials
- bolt cutters
- Ziploc plastic bags
- containers for evacuation of liquids
- decontamination solutions
- tap water
- non-phosphate soap
- several brushes

Table 2: Advantages and Disadvantages
of Various Groundwater Sampling Devices

Device	Advantages	Disadvantages
Bailer	<ul style="list-style-type: none"> ⌘ The only practical limitations are size and materials ⌘ No power source needed ⌘ Portable ⌘ Inexpensive; it can be dedicated and hung in a well reducing the chances of cross-contamination ⌘ Minimal outgassing of volatile organics while sample is in bailer ⌘ Readily available ⌘ Removes stagnant water first ⌘ Rapid, simple method for removing small volumes of purge water 	<ul style="list-style-type: none"> ⌘ Time consuming, especially for large wells ⌘ Transfer of sample may cause aeration
Submersible Pump	<ul style="list-style-type: none"> ⌘ Portable; can be used on an unlimited number of wells ⌘ Relatively high pumping rate (dependent on depth and size of pump) ⌘ Generally very reliable; does not require priming 	<ul style="list-style-type: none"> ⌘ Potential for effects on analysis of trace organics ⌘ Heavy and cumbersome, particularly in deeper wells ⌘ Expensive ⌘ Power source needed ⌘ Susceptible to damage from silt or sediment ⌘ Impractical in low yielding or shallow wells
Non-Gas Contact Bladder Pump	<ul style="list-style-type: none"> ⌘ Maintains integrity of sample ⌘ Easy to use 	<ul style="list-style-type: none"> ⌘ Difficult to clean although dedicated tubing and bladder may be used ⌘ Only useful to approximately 100 feet in depth ⌘ Supply of gas for operation (bottled gas and/or compressor) is difficult to obtain and is cumbersome
Suction Pump	<ul style="list-style-type: none"> ⌘ Portable, inexpensive, and readily available 	<ul style="list-style-type: none"> ⌘ Only useful to approximately 25 feet or less in depth ⌘ Vacuum can cause loss of dissolved gases and volatile organics ⌘ Pump must be primed and vacuum is often difficult to maintain ⌘ May cause pH modification
Inertia Pump	<ul style="list-style-type: none"> ⌘ Portable, inexpensive, and readily available ⌘ Rapid method for purging relatively shallow wells 	<ul style="list-style-type: none"> ⌘ Only useful to approximately 70 feet or less in depth ⌘ May be time consuming to use ⌘ Labor intensive ⌘ WaTerra pump is only effective in 2-inch diameter wells

- pails or tubs
- aluminum foil
- garden sprayer
- preservatives
- distilled or deionized water

2.5.2 Bailer

- clean, decontaminated bailer(s) of appropriate size and construction material
- nylon line, enough to dedicate to each well
- Teflon-coated bailer wire
- sharp knife
- aluminum foil (to wrap clean bailers)
- 5-gallon bucket

2.5.3 Submersible Pump

- pump(s)
- generator (110, 120, or 240 volt) or 12-volt battery if inaccessible to field vehicle
- 1-inch black PVC coil pipe -- enough to dedicate to each well
- hose clamps
- safety cable
- tool box supplement
 - pipe wrenches, 2
 - wire strippers
 - electrical tape
 - heat shrink
 - hose connectors
 - Teflon tape
- winch or pulley
- gasoline for generator
- flow meter with gate valve
- 1-inch nipples and various plumbing (i.e., pipe connectors)

2.5.4 Non-Gas Contact Bladder Pump

- non-gas contact bladder pump
- compressor or nitrogen gas tank
- batteries and charger
- Teflon tubing -- enough to dedicate to each well
- Swagelock fitting
- toolbox supplements -- same as submersible pump

2.5.5 Suction Pump

- pump
- black coil tubing -- enough to dedicate to each well

- gasoline -- if required
- toolbox
- plumbing fittings
- flow meter with gate valve

2.5.6 Inertia Pump

- pump assembly (WaTerra pump, piston Pump)
- 5-gallon bucket

2.6 REAGENTS

Reagents will be utilized for preservation of samples and for decontamination of sampling equipment. The preservation required is specified by the analysis to be performed. Decontamination solutions are specified in ERT SOP #2006, Sampling Equipment Decontamination.

2.7 PROCEDURES

2.7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are needed.
2. Obtain necessary sampling and monitoring equipment.
3. Decontaminate or preclean equipment, and ensure that it is in working order.
4. Prepare scheduling and coordinate with staff, clients, and regulatory agency, if appropriate.
5. Perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.
6. Identify and mark all sampling locations.

2.7.2 Field Preparation

1. Start at the least contaminated well, if known.
2. Lay plastic sheeting around the well to minimize likelihood of contamination of equipment from soil adjacent to the well.

3. Remove locking well cap, note location, time of day, and date in field notebook or an appropriate log form.
4. Remove well casing cap.
5. Screen headspace of well with an appropriate monitoring instrument to determine the presence of volatile organic compounds and record in site logbook.
6. Lower water level measuring device or equivalent (i.e., permanently installed transducers or airline) into well until water surface is encountered.
7. Measure distance from water surface to reference measuring point on well casing or protective barrier post and record in site logbook. Alternatively, if there is no reference point, note that water level measurement is from top of steel casing, top of PVC riser pipe, from ground surface, or some other position on the well head.
8. Measure total depth of well (do this at least twice to confirm measurement) and record in site logbook or on log form.
9. Calculate the volume of water in the well and the volume to be purged using the calculations in Section 2.8.
10. Select the appropriate purging and sampling equipment.

2.7.3 Evacuation of Static Water (Purging)

The amount of flushing a well receives prior to sample collection depends on the intent of the monitoring program as well as the hydrogeologic conditions. Programs where overall quality determination of water resources are involved may require long pumping periods to obtain a sample that is representative of a large volume of that aquifer. The pumped volume can be determined prior to sampling so that the sample is a composite of known volume of the aquifer, or the well can be pumped until the stabilization of parameters such as temperature, electrical conductance, or pH has occurred.

However, monitoring for defining a contaminant plume requires a representative sample of a small volume of the aquifer. These circumstances require that the well be pumped enough to remove the stagnant water but not enough to induce flow from other areas. Generally, three well volumes are considered effective, or calculations can be made to determine, on the basis of the aquifer parameters and well dimensions, the appropriate volume to remove prior to sampling.

During purging, water level measurements may be taken regularly at 15- to 30-second intervals. This data may be used to compute aquifer transmissivity and other hydraulic characteristics.

The following well evacuation devices are most commonly used. Other evacuation devices are available, but have been omitted in this discussion due to their limited use.

Bailer

Bailers are the simplest purging device used and have many advantages. They generally consist of a rigid length of tube, usually with a ball check-valve at the bottom. A line is used to lower the bailer into the well and retrieve a volume of water. The three most common types of bailer are PVC, Teflon, and stainless steel.

This manual method of purging is best suited to shallow or narrow diameter wells. For deep, larger diameter wells which require evacuation of large volumes of water, other mechanical devices may be more appropriate.

Bailing equipment includes a clean decontaminated bailer, Teflon or nylon line, a sharp knife, and plastic sheeting.

1. Determine the volume of water to be purged as described in Section 2.7.2, Field Preparation.
2. Lay plastic sheeting around the well to prevent contamination of the bailer line with foreign materials.
3. Attach the line to the bailer and lower until the bailer is completely submerged.
4. Pull bailer out ensuring that the line either falls onto a clean area of plastic sheeting or never touches the ground.

5. Empty the bailer into a pail until full to determine the number of bails necessary to achieve the required purge volume.
6. Thereafter, pour the water into a container and dispose of purge waters as specified in the site-specific project plan.

Submersible Pump

Submersible pumps are generally constructed of plastic, rubber, and metal parts which may affect the analysis of samples for certain trace organics and inorganics. As a consequence, submersible pumps may not be appropriate for investigations requiring analyses of samples for trace contaminants. However, they are still useful for pre-sample purging. However, the pump must have a check valve to prevent water in the pump and the pipe from rushing back into the well.

Submersible pumps generally use one of two types of power supplies, either electric or compressed gas. Electric pumps can be powered by a 12-volt DC rechargeable battery, or a 110- or 220-volt AC power supply. Those units powered by compressed gas normally use a small electric compressor which also needs 12-volt DC or 110-volt AC power. They may also utilize compressed gas from bottles. Pumps differ according to the depth and diameter of the monitoring wells.

1. Determine the volume of water to be purged as described in section 2.7.2, Field Preparation.
2. Lay plastic sheeting around the well to prevent contamination of pumps, hoses or lines with foreign materials.
3. Assemble pump, hoses and safety cable, and lower the pump into the well. Make sure the pump is deep enough so that purging does not evacuate all the water. (Running the pump without water may cause damage.)
4. Attach flow meter to the outlet hose to measure the volume of water purged.
5. Attach power supply, and purge well until specified volume of water has been evacuated (or until field parameters, such as temperature, pH, conductivity, etc. have stabilized). Do not allow the pump to run dry. If the pumping rate

exceeds the well recharge rate, lower the pump further into the well, and continue pumping.

6. Collect and dispose of purge waters as specified in the site-specific project plan.

Non-Contact Gas Bladder Pump

For this procedure, an all stainless-steel and Teflon Middleburg-squeeze bladder pump (e.g., IEA, TIMCO, Well Wizard, Geoguard, and others) is used to provide the least amount of material interference to the sample (Barcelona, 1985). Water comes into contact with the inside of the bladder (Teflon) and the sample tubing, also Teflon, that may be dedicated to each well. Some wells may have permanently installed bladder pumps (i.e., Well Wizard, Geoguard), that will be used to sample for all parameters.

1. Assemble Teflon tubing, pump and charged control box.
2. Use the same procedure for purging with a bladder pump as for a submersible pump.
3. Be sure to adjust flow rate to prevent violent jolting of the hose as sample is drawn in.

Suction Pump

There are many different types of suction pumps. They include: centrifugal, peristaltic and diaphragm. Diaphragm pumps can be used for well evacuation at a fast pumping rate and sampling at a low pumping rate. The peristaltic pump is a low-volume pump that uses rollers to squeeze the flexible tubing, thereby creating suction. This tubing can be dedicated to a well to prevent cross-contamination. Peristaltic pumps, however, require a power source.

1. Assemble the pump, tubing, and power source if necessary.
2. To purge with a suction pump, follow the exact procedures outlined for the submersible pump.

Inertia Pump

Inertia pumps, such as the WaTerra pump and piston pump, are manually operated. They are appropriate to use when wells are too deep to bail by hand, but are not inaccessible enough to warrant an automatic (submersible, etc.) pump. These

pumps are made of plastic and may be either decontaminated or discarded, after use.

1. Determine the volume of water to be purged as described in Section 2.7.2, Field Preparation.
2. Lay plastic sheeting around the well to prevent contamination of pumps or hoses with foreign materials.
3. Assemble pump, and lower to the appropriate depth in the well.
4. Begin pumping manually, discharging water into a 5-gallon bucket (or other graduated vessel). Purge until specified volume of water has been evacuated (or until field parameters such as temperature, pH, conductivity, etc. have stabilized).
5. Collect and dispose of purge waters as specified in the site-specific project plan.

2.7.4 Sampling

Sample withdrawal methods require the use of pumps, compressed air, bailers, and samplers. Ideally, purging and sample withdrawal equipment should be completely inert, economical to use, easily cleaned, sterilized, reusable, able to operate at remote sites in the absence of power resources, and capable of delivering variable rates for sample collection.

There are several factors to take into consideration when choosing a sampling device. Care should be taken when reviewing the advantages or disadvantages of any one device. It may be appropriate to use a different device to sample than that which was used to purge. The most common example of this is the use of a submersible pump to purge and a bailer to sample.

Bailer

The positive-displacement volatile sampling bailer (by GPI) is perhaps the most appropriate for collection of water samples for volatile analysis. Other bailer types (messenger, bottom fill, etc.) are less desirable, but may be mandated by cost and site conditions. Generally, bailers can provide an acceptable sample, providing that sampling personnel use extra care in the collection process.

1. Surround the monitoring well with clean plastic sheeting.
2. Attach a line to the bailer. If a bailer was used for purging, the same bailer and line may be used for sampling.
3. Lower the bailer slowly and gently into the well, taking care not to shake the casing sides or to splash the bailer into the water. Stop lowering at a point adjacent to the screen.
4. Allow bailer to fill and then slowly and gently retrieve the bailer from the well, avoiding contact with the casing, so as not to knock flakes of rust or other foreign materials into the bailer.
5. Remove the cap from the sample container and place it on the plastic sheet or in a location where it will not become contaminated. See Section 2.7.7 for special considerations on VOA samples.
6. Begin pouring slowly from the bailer.
7. Filter and preserve samples as required by sampling plan.
8. Cap the sample container tightly and place pre-labeled sample container in a carrier.
9. Replace the well cap.
10. Log all samples in the site logbook and on field data sheets and label all samples.
11. Package samples and complete necessary paperwork.
12. Transport sample to decontamination zone to prepare it for transport to analytical laboratory.

Submersible Pump

Although it is recommended that samples not be collected with a submersible pump due to the reasons stated in Section 2.4, there are some situations where they may be used.

1. Allow the monitoring well to recharge after purging, keeping the pump just above the screened section,

2. Attach gate valve to hose (if not already fitted), and reduce flow of water to a manageable sampling rate.
3. Assemble the appropriate bottles.
4. If no gate valve is available, run the water down the side of a clean jar and fill the sample bottles from the jar.
5. Cap the sample container tightly and place pre-labeled sample container in a carrier.
6. Replace the well cap.
7. Log all samples in the site logbook and on the field data sheets and label all samples.
8. Package samples and complete necessary paperwork.
9. Transport sample to decontamination zone for preparation for transport to analytical laboratory.
10. Upon completion, remove pump and assembly and fully decontaminate prior to setting into the next sample well. Dedicate the tubing to the hole.
3. Turn pump on, increase the cycle time and reduce the pressure to the minimum that will allow the sample to come to the surface.
4. Cap the sample container tightly and place pre-labeled sample container in a carrier.
5. Replace the well cap.
6. Log all samples in the site logbook and on field data sheets and label all samples.
7. Package samples and complete necessary paperwork.
8. Transport sample to decontamination zone for preparation for transport to analytical laboratory.
9. On completion, remove the tubing from the well and either replace the Teflon tubing and bladder with new dedicated tubing and bladder or rigorously decontaminate the existing materials.
10. Collect non-filtered samples directly from the outlet tubing into the sample bottle.
11. For filtered samples, connect the pump outlet tubing directly to the filter unit. The pump pressure should remain decreased so that the pressure build-up on the filter does not blow out the pump bladder or displace the filter. For the Geotech barrel filter, no actual connections are necessary so this is not a concern.

Non-Gas Contact Bladder Pump

The use of a non-gas contact positive displacement bladder pump is often mandated by the use of dedicated pumps installed in wells. These pumps are also suitable for shallow (less than 100 feet) wells. They are somewhat difficult to clean, but may be used with dedicated sample tubing to avoid cleaning. These pumps require a power supply and a compressed gas supply (or compressor). They may be operated at variable flow and pressure rates making them ideal for both purging and sampling.

Barcelona (1984) and Nielsen (1985) report that the non-gas contact positive displacement pumps cause the least amount of alteration in sample integrity as compared to other sample retrieval methods.

1. Allow well to recharge after purging.
2. Assemble the appropriate bottles.

Suction Pump

In view of the limitations of suction pumps, they are not recommended for sampling purposes.

Inertia Pump

Inertia pumps may be used to collect samples. It is more common, however, to purge with these pumps and sample with a bailer.

1. Following well evacuation, allow the well to recharge.
2. Assemble the appropriate bottles.

3. Since these pumps are manually operated, the flow rate may be regulated by the sampler. The sample may be discharged from the pump outlet directly into the appropriate sample container.
4. Cap the sample container tightly and place pre-labeled sample container in a carrier.
5. Replace the well cap.
6. Log all samples in the site logbook and on field data sheets and label all samples.
7. Package samples and complete necessary paperwork.
8. Transport sample to decontamination zone for preparation for transport to analytical laboratory.
9. Upon completion, remove pump and decontaminate or discard, as appropriate.

2.7.5 Filtering

For samples that require filtering, such as samples which will be analyzed for total metals, the filter must be decontaminated prior to use and between uses. Filters work by two methods. A barrel filter such as the “Geotech” filter works with a bicycle pump, which is used to build up positive pressure in the chamber containing the sample. The sample is then forced through the filter paper (minimum size 0.45 μ) into a jar placed underneath. The barrel itself is filled manually from the bailer or directly via the hose of the sampling pump. The pressure must be maintained up to 30 psi by periodic pumping.

A vacuum type filter involves two chambers, the upper chamber contains the sample and a filter (minimum size 0.45 μ) divides the chambers. Using a hand pump or a Gilian type pump, air is withdrawn from the lower chamber, creating a vacuum and thus causing the sample to move through the filter into the lower chamber where it is drained into a sample jar, repeated pumping may be required to drain all the sample into the lower chamber. If preservation of the sample is necessary, this should be done after filtering.

2.7.6 Post Operation

After all samples are collected and preserved, the sampling equipment should be decontaminated prior to sampling another well. This will prevent cross-contamination of equipment and monitoring wells between locations.

1. Decontaminate all equipment.
2. Replace sampling equipment in storage containers.
3. Prepare and transport water samples to the laboratory. Check sample documentation and make sure samples are properly packed for shipment.

2.7.7 Special Considerations for VOA Sampling

The proper collection of a sample for volatile organics requires minimal disturbance of the sample to limit volatilization and therefore a loss of volatiles from the sample.

Sample retrieval systems suitable for the valid collection of volatile organic samples are: positive displacement bladder pumps, gear driven submersible pumps, syringe samplers and bailers (Barcelona, 1984; Nielsen, 1985). Field conditions and other constraints will limit the choice of appropriate systems. The focus of concern must be to provide a valid sample for analysis, one which has been subjected to the least amount of turbulence possible.

The following procedures should be followed:

1. Open the vial, set cap in a clean place, and collect the sample during the middle of the cycle. When collecting duplicates, collect both samples at the same time.
2. Fill the vial to just overflowing. Do not rinse the vial, nor excessively overfill it. There should be a convex meniscus on the top of the vial.
3. Check that the cap has not been contaminated (splashed) and carefully cap the vial. Place the cap directly over the top and screw down firmly. Do not overtighten and break the cap.

4. Invert the vial and tap gently. Observe vial for at least 10 seconds. If an air bubble appears, discard the sample and begin again. It is imperative that no entrapped air is in the sample vial.
5. Immediately place the vial in the protective foam sleeve and place into the cooler, oriented so that it is lying on its side, not straight up.
6. The holding time for VOAs is 7 days. Samples should be shipped or delivered to the laboratory daily so as not to exceed the holding time. Ensure that the samples remain at 4°C, but do not allow them to freeze.

2.8 CALCULATIONS

There are no calculations necessary to implement this procedure. However, if it is necessary to calculate the volume of the well, utilize the following equation:

$$\text{Well volume} = \pi r^2 h (\text{cf}) \quad [\text{Equation 1}]$$

where:

$$\begin{aligned} \pi &= \text{radius of monitoring well (feet)} \\ r &= \text{height of the water column (feet)} \\ &\quad [\text{This may be determined by subtracting the depth to water from the total depth of the well as measured from the same reference point.}] \\ \text{cf} &= \text{conversion factor (gal/ft}^3\text{)} = 7.48 \text{ gal/ft}^3 \text{ [In this equation, 7.48 gal/ft}^3 \text{ is the necessary conversion factor.]} \end{aligned}$$

Monitoring wells are typically 2, 3, 4, or 6 inches in diameter. If you know the diameter of the monitoring well, there are a number of standard conversion factors which can be used to simplify the equation above.

The volume, in gallons per linear foot, for various standard monitoring well diameters can be calculated as follows:

$$v = \pi r^2 (\text{cf}) \quad [\text{Equation 2}]$$

where:

$$\begin{aligned} v &= \text{volume in gallons per linear foot} \\ \pi &= \text{pi} \\ r &= \text{radius of monitoring well (feet)} \\ \text{cf} &= \text{conversion factor (7.48 gal/ft}^3\text{)} \end{aligned}$$

For a 2-inch diameter well, the volume in gallons per linear foot can be calculated as follows:

$$\begin{aligned} v &= \pi r^2 (\text{cf}) \quad [\text{Equation 2}] \\ &= 3.14 (1/12 \text{ ft})^2 7.48 \text{ gal/ft}^3 \\ &= 0.1632 \text{ gal/ft} \end{aligned}$$

Remember that if you have a 2-inch diameter, well you must convert this to the radius in feet to be able to use the equation.

The volume in gallons per linear foot for the common size monitoring wells are as follows:

<u>Well Diameter</u>	<u>v (volume in gal/ft.)</u>
2 inches	0.1632
3 inches	0.3672
4 inches	0.6528
6 inches	1.4688

If you utilize the conversion factors above, Equation 1 should be modified as follows:

$$\text{Well volume} = (h)(v) \quad [\text{Equation 3}]$$

where:

$$\begin{aligned} h &= \text{height of water column (feet)} \\ v &= \text{volume in gallons per linear foot as calculated from Equation 2} \end{aligned}$$

2.9 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following general QA procedures apply:

- ☞ All data must be documented on field data sheets or within site logbooks.
- ☞ All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless

otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

2.10 DATA VALIDATION

This section is not applicable to this SOP.

2.11 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA and specific health and safety procedures. More specifically, depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling the first well. The site health and safety plan should be reviewed with specific emphasis placed on the protection program planned for the well sampling tasks. Standard safe operating practices should be followed such as minimizing contact with potential contaminants in both the vapor phase and liquid matrix through the use of respirators and disposable clothing.

For volatile organic contaminants:

- ⚡ Avoid breathing constituents venting from the well.

- ⚡⚡ Pre-survey the well head-space with an FID/PID prior to sampling.
- ⚡⚡ If monitoring results indicate organic constituents, sampling activities may be conducted in Level C protection. At a minimum, skin protection will be afforded by disposable protective clothing.

Physical hazards associated with well sampling are:

- ⚡ Lifting injuries associated with pump and bailer retrieval; moving equipment.
- ⚡ Use of pocket knives for cutting discharge hose.
- ⚡ Heat/cold stress as a result of exposure to extreme temperatures (may be heightened by protective clothing).
- ⚡⚡ Slip, trip, fall conditions as a result of pump discharge.
- ⚡ Restricted mobility due to the wearing of protective clothing.

3.0 SOIL GAS SAMPLING: SOP #2149

3.1 SCOPE AND APPLICATION

Soil gas monitoring provides a quick means of waste site evaluation. Using this method, underground contamination can be identified, and the source, extent, and movement of the pollutants can be traced.

This Standard Operating Procedure (SOP) outlines the methods used by EPA/ERT in installing soil gas wells; measuring organic levels in the soil gas using an HNU PI 101 Portable Photoionization Analyzer and/or other air monitoring devices; and sampling the soil gas using Tedlar bags, Tenax sorbent tubes, and SUMMA canisters.

3.2 METHOD SUMMARY

A 3/8-inch diameter hole is driven into the ground to a depth of 4 to 5 feet using a commercially available “slam bar”. (Soil gas can also be sampled at other depths by the use of a longer bar or bar attachments.) A 1/2-inch O.D. stainless steel probe is inserted into the hole. The hole is then sealed at the top around the probe using modeling clay. The gas contained in the interstitial spaces of the soil is sampled by pulling the sample through the probe using an air sampling pump. The sample may be stored in Tedlar bags, drawn through sorbent cartridges, or analyzed directly using a direct reading instrument.

The air sampling pump is not used for SUMMA canister sampling of soil gas. Sampling is achieved by soil gas equilibration with the evacuated SUMMA canister. Other field air monitoring devices, such as the combustible gas indicator (MSA CGI/02 Meter, Model 260) and the organic vapor analyzer (Foxboro OVA, Model 128), can also be used depending on specific site conditions. Measurement of soil temperature using a temperature probe may also be desirable. Bagged samples are usually analyzed in a field laboratory using a portable Photovac GC.

Power driven sampling probes may be utilized when soil conditions make sampling by hand unfeasible (i.e., frozen ground, very dense clays, pavement,

etc.). Commercially available soil gas sampling probes (hollow, 1/2-inch O.D. steel probes) can be driven to the desired depth using a power hammer (e.g., Bosch Demolition Hammer). Samples can be drawn through the probe itself, or through Teflon tubing inserted through the probe and attached to the probe point. Samples are collected and analyzed as described above.

3.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

3.3.1 Tedlar Bag

Soil gas samples are generally contained in 1-L Tedlar bags. Bagged samples are best stored in coolers to protect the bags from any damage that may occur in the field or in transit. In addition, coolers ensure the integrity of the samples by keeping them at a cool temperature and out of direct sunlight. Samples should be analyzed as soon as possible, preferably within 24 to 48 hours.

3.3.2 Tenax Tube

Bagged samples can also be drawn into Tenax or other sorbent tubes to undergo lab GC/MS analysis. If Tenax tubes are to be utilized, special care must be taken to avoid contamination. Handling of the tubes should be kept to a minimum, and samplers must wear nylon or other lint-free gloves. After sampling, each tube should be stored in a clean, sealed culture tube; the ends packed with clean glass wool to protect the sorbent tube from breakage. The culture tubes should be kept cool and wrapped in aluminum foil to prevent any photodegradation of samples (see Section 3.7.4.).

3.3.3 SUMMA Canister

The SUMMA canisters used for soil gas sampling have a 6-L sample capacity and are certified clean by GC/MS analysis before being utilized in the field. After sampling is completed, they are stored and shipped in travel cases.

3.4 INTERFERENCES AND POTENTIAL PROBLEMS

3.4.1 HNU Measurements

A number of factors can affect the response of the HNU PI 101. High humidity can cause lamp fogging and decreased sensitivity. This can be significant when soil moisture levels are high, or when a soil gas well is actually in groundwater. High concentrations of methane can cause a downscale deflection of the meter. High and low temperature, electrical fields, FM radio transmission, and naturally occurring compounds, such as terpenes in wooded areas, will also affect instrument response.

Other field screening instruments can be affected by interferences. Consult the manufacturers' manuals.

3.4.2 Factors Affecting Organic Concentrations in Soil Gas

Concentrations in soil gas are affected by dissolution, adsorption, and partitioning. Partitioning refers to the ratio of component found in a saturated vapor above an aqueous solution to the amount in the solution; this can, in theory, be calculated using the Henry's Law constants. Contaminants can also be adsorbed onto inorganic soil components or "dissolved" in organic components. These factors can result in a lowering of the partitioning coefficient.

Soil "tightness" or amount of void space in the soil matrix, will affect the rate of recharging of gas into the soil gas well.

Existence of a high, or perched, water table, or of an impermeable underlying layer (such as a clay lens or layer of buried slag) may interfere with sampling of the soil gas. Knowledge of site geology is useful in such situations, and can prevent inaccurate sampling.

3.4.3 Soil Probe Clogging

A common problem with this sampling method is soil probe clogging. A clogged probe can be identified by using an in-line vacuum gauge or by listening for the sound of the pump laboring. This problem can usually be eliminated by using a wire cable to clear the probe (see procedure #3 in Section 3.7.1).

3.4.4 Underground Utilities

Prior to selecting sample locations, an underground utility search is recommended. The local utility companies can be contacted and requested to mark the locations of their underground lines. Sampling plans can then be drawn up accordingly. Each sample location should also be screened with a metal detector or magnetometer to verify that no underground pipes or drums exist.

3.5 EQUIPMENT/APPARATUS

3.5.1 Slam Bar Method

- slam bar (one per sampling team)
- soil gas probes, stainless steel tubing, 1/4-inch O.D., 5 foot length
- flexible wire or cable used for clearing the tubing during insertion into the well
- "quick connect" fittings to connect sampling probe tubing, monitoring instruments, and Gilian pumps to appropriate fittings on vacuum box
- modeling clay
- vacuum box for drawing a vacuum around Tedlar bag for sample collection (one per sampling team)
- Gilian pump Model HFS113A adjusted to approximately 3.0 L/min (one to two per sampling team)
- 1/4-inch Teflon tubing, 2 to 3 foot lengths, for replacement of contaminated sample line
- Tedlar bags, 1 liter, at least one bag per sample point
- soil gas sampling labels, field data sheets, logbook, etc.
- HNU Model PI 101, or other field air monitoring devices, (one per sampling team)
- ice chest, for carrying equipment and for protection of samples (two per sampling team)
- metal detector or magnetometer, for detecting underground utilities/pipes/drums (one per sampling team)
- Photovac GC, for field-lab analysis of bagged samples
- SUMMA canisters (plus their shipping cases) for sample, storage and transportation

3.5.2 Power Hammer Method

- Bosch demolition hammer
- 1/2inch O.D. steel probes, extensions, and points
- dedicated aluminum sampling points
- Teflon tubing, 1/Cinch O.D.
- “quick connect” fittings to connect sampling probe tubing, monitoring instruments, and Gilian pumps to appropriate fittings on vacuum box
- modeling clay
- vacuum box for drawing a vacuum around Tedlar bag for sample collection (one per sampling team)
- Gilian pump Model HFS113A adjusted to approximately 3.0 L/min (one to two per sampling team)
- 1/4-inch Teflon tubing, 2 to 3 foot lengths, for replacement of contaminated sample line
- Tedlar bags, 1 liter, at least one bag per sample point
- soil gas sampling labels, field data sheets, logbook, etc.
- HNU Model PI 101, or other field air monitoring devices, (one per sampling team)
- ice chest, for carrying equipment and for protection of samples (two per sampling team)
- metal detector or magnetometer, for detecting underground utilities/pipes/drums (one per sampling team)
- Photovac GC, for field-lab analysis of bagged samples
- SUMMA canisters (plus their shipping cases) for sample, storage and transportation
- generator with extension cords
- high lift jack assembly for removing probes

3.6 REAGENTS

- HNU Systems Inc. Calibration Gas for HNU Model PI 101, and/or calibration gas for other field air monitoring devices
- deionized organic-free water, for decontamination
- methanol, HPLC grade, for decontamination
- ultra-zero grade compressed air, for field blanks

- standard gas preparations for Photovac GC calibration and Tedlar bag spikes

3.7 PROCEDURES

3.7.1 Soil Gas Well Installation

1. Initially, make a hole slightly deeper than the desired depth. For sampling up to 5 feet, use a 5-foot single piston slam bar. For deeper depths, use a piston slam bar with threaded 4-foot-long extensions. Other techniques can be used, so long as holes are of narrow diameter and no contamination is introduced.
2. After the hole is made, carefully withdraw the slam bar to prevent collapse of the walls of the hole. Then insert the soil gas probe.
3. It is necessary to prevent plugging of the probe, especially for deeper holes. Place a metal wire or cable, slightly longer than the probe, into the probe prior to inserting into the hole. Insert the probe to full depth, then pull it up 3 to 6 inches, then clear it by moving the cable up and down. The cable is removed before sampling.
4. Seal the top of the sample hole at the surface against ambient air infiltration by using modeling clay molded around the probe at the surface of the hole.
5. If conditions preclude hand installation of the soil gas wells, the power driven system may be employed. Use the generator-powered demolition hammer to drive the probe to the desired depth (up to 12 feet may be attained with extensions). Pull the probe up 1 to 3 inches if the retractable point is used. No clay is needed to seal the hole. After sampling, retrieve the probe using the high lift jack assembly.
6. If semi-permanent soil gas wells are required, use the dedicated aluminum probe points. Insert these points into the bottom of the power-driven probe and attach it to the Teflon tubing. Insert the probe as in step 5. When the probe is removed, the point and Teflon tube remain in the hole, which may be sealed by backfilling with sand, bentonite, or soil.

3.7.2 Screening with Field Instruments

1. The **well** volume **must** be evacuated prior to sampling. Connect the Gilian pump, adjusted to 3.0 L/min, to the sample probe using a section of Teflon tubing as a connector. Turn the pump on, and a vacuum is pulled through the probe for approximately 15 seconds. A longer time is required for sample wells of greater depths.
2. After evacuation, connect the monitoring instrument(s) to the probe using a Teflon connector. When the reading is stable, or peaks, record the reading. For detailed procedures on HNU field protocol, see appendix B, and refer to the manufacturer's instructions.
3. Some readings may be above or below the range set on the field instruments. The range may be reset, or the response recorded as a figure greater than or less than the range. Consider the recharge rate of the well with soil gas when sampling at a different range setting.

3.7.3 Tedlar Bag Sampling

1. Follow step 1 in section 3.7.2 to evacuate well volume. If air monitoring instrument screening was performed prior to sampling, evacuation is not necessary.
2. Use the vacuum box and sampling train (Figure 3 in Appendix A) to take the sample. The sampling train is designed to minimize the introduction of contaminants and losses due to adsorption. All wetted parts are either Teflon or stainless steel. The vacuum is drawn indirectly to avoid contamination from sample pumps.
3. Place the Tedlar bag inside the vacuum box, and attach it to the sampling port. Attach the sample probe to the sampling port via Teflon tubing and a "quick connect" fitting.
4. Draw a vacuum around the outside of the bag, using a Gilian pump connected to the vacuum box evacuation port, via Tygon tubing and a "quick connect" fitting. The vacuum causes the bag to inflate, drawing the sample.

5. Break the vacuum by removing the Tygon line from the pump. Remove the bagged sample from the box and close valve. Label bag, record data on data sheets or in logbooks. Record the date, time, sample location ID, and the HNU, or other instrument reading(s) on sample bag label.

CAUTION: Labels should not be pasted directly onto the bags, nor should bags be labeled directly using a marker or pen. Inks and adhesive may diffuse through the bag material, contaminating the sample. Place labels on the edge of the bags, or tie the labels to the metal eyelets provided on the bags. Markers with inks containing volatile organics (i.e., permanent ink markers) should not be used.

3.7.4 Tenax Tube Sampling

Samples collected in Tedlar bags may be sorbed onto Tenax tubes for further analysis by GC/MS.

Additional Apparatus

- ☞ Syringe with a luer-lock tip capable of drawing a soil gas or air sample from a Tedlar bag onto a Tenax/CMS sorbent tube. The syringe capacity is dependent upon the volume of sample being drawn onto the sorbent tube.
- ☞ Adapters for fitting the sorbent tube between the Tedlar bag and the sampling syringe. The adapter attaching the Tedlar bag to the sorbent tube consists of a reducing union (1/Cinch to 1/16-inch O.D. -- Swagelok cat. # SS-400-6-ILV or equivalent) with a length of 1/4 inch O.D. Teflon tubing replacing the nut on the 1/6-inch (Tedlar bag) side. A 1/Cinch I.D. silicone O-ring replaces the ferrules in the nut on the 1/Cinch (sorbent tube) side of the union.

The adapter attaching the sampling syringe to the sorbent tube consists of a reducing union (1/Cinch to 1/16-inch O.D. -- Swagelok Cat. # SS-400-6-ILV or equivalent) with a 1/Cinch I.D. silicone O-ring replacing the ferrules in the nut on the 1/4 inch (sorbent tube) side and the needle of a luer-lock syringe needle inserted into the 1/16-inch side (held in place with a 1/16-inch ferrule). The

luer-lock end of the needle can be attached to the sampling syringe. It is useful to have a luer-lock on/off valve situated between the syringe and the needle.

☞ Two-stage glass sampling cartridge (1/4-inch O.D. x 1/8-inch I.D. x 5 1/8 inch) contained in a flame-sealed tube (manufactured by Supelco Custom Tenax/Spherocarb Tubes or equivalent) containing two sorbent sections retained by glass wool:

Front section: 150 mg of Tenax-GC
Back section: 150 mg of CMS
(Carbonized Molecular Sieve)

Sorbent tubes may also be prepared in the lab and stored in either Teflon-capped culture tubes or stainless steel tube containers. Sorbent tubes stored in this manner should not be kept more than 2 weeks without reconditioning. (See SOP #2052 for Tenax/CMS sorbent tube preparation).

☞ Teflon-capped culture tubes or stainless steel tube containers for sorbent tube storage. These containers should be conditioned by baking at 120°C for at least 2 hours. The culture tubes should contain a glass wool plug to prevent sorbent tube breakage during transport. Reconditioning of the containers should occur between usage or after extended periods of disuse (i.e., 2 weeks or more).

☞ Nylon gloves or lint-free cloth. (Hewlett Packard Part # 8650-0030 or equivalent.)

Sample Collection

1. Handle sorbent tubes with care, using nylon gloves (or other lint-free material) to avoid contamination.
2. Immediately before sampling, break one end of the sealed tube and remove the Tenax cartridge. For in-house prepared tubes, remove cartridge from its container.
3. Connect the valve on the Tedlar bag to the sorbent tube adapter. Connect the sorbent tube to the sorbent tube adapter with the Tenax

(white granular) side of the tube facing the Tedlar bag.

4. Connect the sampling syringe assembly to the CMS (black) side of the sorbent tube. Fittings on the adapters should be very tight.
5. Open the valve on the Tedlar bag.
6. Open the on/off valve of the sampling syringe.
7. Draw a predetermined volume of sample onto the sorbent tube. (This may require closing the syringe valve, emptying the syringe and then repeating the procedure, depending upon the syringe capacity and volume of sample required.)
8. After sampling, remove the tube from the sampling train with gloves or a clean cloth. **Do not label or write on the Tenax/CMS tube.**
9. Place the sorbent tube in a conditioned stainless steel tube holder or culture tube. Culture tube caps should be sealed with Teflon tape.

Sample Labeling

Each sample tube container (not tube) must be labeled with the site name, sample station number, sample date, and sample volume.

Chain of custody forms must accompany all samples to the laboratory.

Quality Assurance

Before field use, a QA check should be performed on each batch of sorbent tubes by analyzing a tube with thermal desorption/cryogenic trapping GC/MS.

At least one blank sample must be submitted with each set of samples collected at a site. This trip blank must be treated the same as the sample tubes except no sample will be drawn through the tube.

Sample tubes should be stored out of UV light (i.e., sunlight) and kept on ice until analysis.

Samples should be taken in duplicate, when possible.

3.7.5 SUMMA Canister Sampling

1. Follow item 1 in step 3.7.2 to evacuate well volume. If HNU analysis was performed prior to taking a sample, evacuation is not necessary.
2. Attach a certified clean, evacuated 6-L SUMMA canister via the 1/4-inch Teflon tubing.
3. Open the valve on SUMMA canister. The soil gas sample is drawn into the canister by pressure equilibration. The approximate sampling time for a 6-L canister is 20 minutes.
4. Site name, sample location, number, and date must be recorded on a chain of custody form and on a blank tag attached to the canister.

3.8 CALCULATIONS

3.8.1 Field Screening Instruments

Instrument readings are usually read directly from the meter. In some cases, the background level at the soil gas station may be subtracted:

$$\text{Final Reading} = \text{Sample Reading} - \text{Background}$$

3.8.2 Photovac GC Analysis

Calculations used to determine concentrations of individual components by Photovac GC analysis are beyond the scope of this SOP and are covered in ERT SOP #2109, Photovac GC Analysis for Soil, Water and Air/Soil Gas.

3.9 QUALITY ASSURANCE/ QUALITY CONTROL

3.9.1 Field Instrument Calibration

Consult the manufacturers' manuals for correct use and calibration of all instrumentation. The HNU should be calibrated at least once a day.

3.9.2 Gilian Model HFS113A Air Sampling Pump Calibration

Flow should be set at approximately 3.0 L/min;

accurate flow adjustment is not necessary. Pumps should be calibrated prior to bringing into the field.

3.9.3 Sample Probe Contamination

Sample probe contamination is checked between each sample by drawing ambient air through the probe via a Gilian pump and checking the response of the HNU PI 101. If HNU readings are higher than background, replacement or decontamination is necessary.

Sample probes may be decontaminated simply by drawing ambient air through the probe until the HNU reading is at background. More persistent contamination can be washed out using methanol and water, then air drying. Having more than one probe per sample team will reduce lag times between sample stations while probes are decontaminated.

3.9.4 Sample Train Contamination

The Teflon line forming the sample train from the probe to the Tedlar bag should be changed on a daily basis. If visible contamination (soil or water) is drawn into the sampling train, it should be changed immediately. When sampling in highly contaminated areas, the sampling train should be purged with ambient air, via a Gilian pump, for approximately 30 seconds between each sample. After purging, the sampling train can be checked using an HNU, or other field monitoring device, to establish the cleanliness of the Teflon line.

3.9.5 Field Blank

Each cooler containing samples should also contain one Tedlar bag of ultra-zero grade air, acting as a field blank. The field blank should accompany the samples in the field (while being collected) and when they are delivered for analysis. A fresh blank must be provided to be placed in the empty cooler pending additional sample collection. One new field blank per cooler of samples is required. A chain of custody form must accompany each cooler of samples and should include the blank that is dedicated to that group of samples.

3.9.6 Trip Standard

Each cooler containing samples should contain a Tedlar bag of standard gas to calibrate the

analytical instruments (Photovac GC, etc.). This trip standard will be used to determine any changes in concentrations of the target compounds during the course of the sampling day (e.g., migration through the sample bag, degradation, or adsorption). A fresh trip standard must be provided and placed in each cooler pending additional sample collection. A chain of custody form should accompany each cooler of samples and should include the trip standard that is dedicated to that group of samples.

3.9.7 Tedlar Bag Check

Prior to use, one bag should be removed from each lot (case of 100) of Tedlar bags to be used for sampling and checked for possible contamination as follows: the test bag should be tilled with ultra-zero grade air; a sample should be drawn from the bag and analyzed via Photovac GC or whatever method is to be used for sample analysis. This procedure will ensure sample container cleanliness prior to the start of the sampling effort.

3.9.8 SUMMA Canister Check

From each lot of four cleaned SUMMA canisters, one is to be removed for a GC/MS certification check. If the canister passes certification, then it is re-evacuated and all four canisters from that lot are available for sampling.

If the chosen canister is contaminated, then the entire lot of four SUMMA canisters must be recleaned, and a single canister is re-analyzed by GC/MS for certification.

3.9.9 Options

Duplicate Samples

A minimum of 5% of all samples should be collected in duplicate (i.e., if a total of 100 samples are to be collected, five samples should be duplicated). In choosing which samples to duplicate, the following criterion applies: if, after filling the first Tedlar bag, and, evacuating the well for 15 seconds, the second HNU (or other field monitoring device being used) reading matches or is close to (within 50%) the first reading, a duplicate sample may be taken.

Spikes

A Tedlar bag spike and Tenax tube spike may be desirable in situations where high concentrations of contaminants other than the target compounds are found to exist (landfills, etc.). The additional level of QA/QC attained by this practice can be useful in determining the effects of interferences caused by these non-target compounds. SUMMA canisters containing samples are not spiked.

3.10 DATA VALIDATION

For each target compound, the level of concentration found in the sample must be greater than three times the level (for that compound) found in the field blank which accompanied that sample to be considered valid. The same criteria apply to target compounds detected in the Tedlar bag pre-sampling contamination check.

3.11 HEALTH AND SAFETY

Because the sample is being drawn from underground, and no contamination is introduced into the breathing zone, soil gas sampling usually occurs in Level D, unless the sampling location is within the hot zone of a site, which requires Level B or Level C protection. However, to ensure that the proper level of protection is utilized, constantly monitor the ambient air using the HNU PI 101 to obtain background readings during the sampling procedure. As long as the levels in ambient air do not rise above background, no upgrade of the level of protection is needed.

Also, perform an underground utility search prior to sampling (see section 3.4.4). When working with potentially hazardous materials, follow U.S. EPA, OSHA, and specific health and safety procedures.

4.0 MONITORING WELL INSTALLATION: SOP #2150

4.1 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide an overview of the methods used for monitoring well installation. Monitoring well installation creates a permanent access for the collection of samples to determine groundwater quality and the hydrogeologic properties of the aquifer in which the contaminants exist. Such wells should not alter the medium which is being monitored.

The most commonly used drilling methods are: (1) hollow-stem augers, (2) cable tool drills, and (3) rotary drills. Rotary drilling can be divided into a mud rotary or air rotary method.

4.2 METHOD SUMMARY

There is no ideal monitoring well installation method for all conditions; therefore, hydrogeologic conditions at the site and project objectives must be considered before deciding which drilling method to use.

4.2.1 Hollow-Stem Augering

Hollow-stem augering is fast and relatively less expensive than cable tool or rotary drilling methods. It is possible to drill several hundred feet of borehole per day in unconsolidated formations.

4.2.2 Cable Tool Drilling

Cable tool drilling method involves lifting and dropping a heavy, solid chisel-shaped bit, suspended on a steel cable. This bit pounds a hole through soil and rock. Temporary steel casing is used while drilling to keep the hole open and to isolate strata. The temporary casing is equipped with a drive shoe, which is attached to the lower end, and which aids the advancement of the casing by drilling out a slightly larger diameter borehole than the hole made by the drill bit alone.

Water is sometimes used when drilling above the saturated zone to reduce dust and to form a slurry with the loosened material. This facilitates removal of cuttings using a bailer or a sand pump. Potable

water or distilled/deionized water should be used to prevent the introduction of contamination into the borehole.

4.2.3 Rotary Drilling

Mud Rotary Method

In the mud rotary method, the borehole is advanced by rapid rotation of the drill bit, which cuts and breaks the material at the bottom of the hole into smaller pieces. Cuttings are removed by pumping drilling fluid (water, or water mixed with bentonite) down through the drill rods and bit, and up the annulus between the borehole and the drill rods. The drilling fluid also serves to cool the drill bit and prevent the borehole from collapsing in unconsolidated formations.

Air Rotary Method

The air rotary method is the same as the mud rotary except that compressed air is pumped down the drill rods and returns with the drill cuttings up through the annulus. Air rotary method is generally limited to consolidated and semi-consolidated formations. Casing is sometimes used to prevent cavings in semi-consolidated formations. The air must be filtered to prevent introduction of contamination into the borehole.

4.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Often, a primary object of the drilling program is to obtain representative lithologic or environmental samples. Lithologic samples are taken in order to determine the geologic or hydrogeologic regime at a site. The most common techniques for retrieving lithologic samples in unconsolidated formations are described below.

Split spoon sampling, carried out continuously or at discrete intervals during drilling, is used to make a field description of the sample and create a log of each boring.

⚡ Shelby tube sampling, is used when an undisturbed sample is required from clayey or silty soils, especially for geotechnical evaluation or chemical analysis.

⚡ Cuttings description is used when a general lithologic description and approximate depths are sufficient.

The most common techniques for retrieving lithologic sampling in consolidated formations are described below.

⚡ Rock coring is carried out continuously or at discrete intervals during drilling and enables the geologist to write a field description of the sample, create a log of each boring, and map occurrences and orientation of fractures.

⚡ Cuttings description is used when a general lithologic description and approximate depths are sufficient.

4.4 INTERFERENCES AND POTENTIAL PROBLEMS

Table 3 on page 27 displays the advantages and disadvantages of the various drilling techniques.

4.5 EQUIPMENT/APPARATUS

The drilling contractor will provide all operational equipment for the drilling program which is outlined. The geologist should bring:

- well log sheets
- ⚡ metal case (container for well logs)
- ruler
- ⚡ depth sounder
- ⚡ water level indicator
- ⚡ all required health and safety gear
- ⚡ sample collection jars
- ⚡ trowels
- ⚡ description aids (Munsell, grain size charts, etc.)

4.6 REAGENTS

No chemical reagents are used in this procedure. Decontamination of drilling equipment should

follow ERT SOP #2006, Sampling Equipment Decontamination and the site-specific work plan.

4.7 PROCEDURES

4.7.1 Preparation

The planning, selection and implementation of any monitoring well installation program should include the following steps.

1. Review existing data on site geology and hydrogeology including publications, air photos, water quality data, and existing maps. These may be obtained from local, state, or federal agencies.
2. Visit the site to observe field geology and potential access problems for drill rig, to establish water supply, and drill equipment and materials storage area.
3. Prepare site safety plan.
4. Define project objectives; select drilling, well development, and sampling methods.
5. Select well construction materials including well construction specifications (i.e., casing and screen materials, casing and screen diameter, screen length and screen interval, filter pack and screen size).
6. Determine need for containing drill cuttings/fluids and their disposal.
7. Prepare work plan including all of the above.
8. Prepare and execute the drilling contract.
9. Implement the drilling program.
10. Prepare the final report, including background data, project objective, field procedure, well construction data including well logs and well construction.

All drilling and well installation programs must be planned and supervised by a professional geologist/hydrogeologist.

4.7.2 Field Preparation

1. Prior to the mobilization of the drill rig,

Table 3: Advantages and Disadvantages of Various Drilling Techniques

Drilling Type	Advantages	Disadvantages
Auger	<ul style="list-style-type: none"> ⚡⚡ Allows sampling from different strata during drilling. ⚡⚡ Less potential for cross-contamination between strata than in other techniques. ⚡⚡ Large diameter borehole may be drilled for multiple-well completion. ⚡⚡ Less well development is generally needed than in mud rotary because of the relatively large diameter borehole, the ability to emplace a large and effective gravel pack, and because no drilling fluids are introduced into the borehole. 	<ul style="list-style-type: none"> ⚡⚡ Very slow or impossible in coarse materials such as cobbles and boulders. ⚡ Cannot drill hard rock formations and is generally not suited for wells deeper than 100 feet. ⚡⚡ Not good in caving formations. ⚡⚡ Potential for disturbing large volume of subsurface materials around the borehole; therefore affecting local permeabilities and creating annular channels for contaminant movement between different strata.
Cable Tool	<ul style="list-style-type: none"> ⚡⚡ Allows for easy and accurate detection of the water table. ⚡⚡ Driven casing seals off formation, minimizing the threat of cross-contamination in pollution investigation. ⚡⚡ Especially successful for drilling in glacial till. 	<ul style="list-style-type: none"> ⚡⚡ Extremely slow rate of drilling. ⚡⚡ Can lose casing in deep wells.
Mud Rotary	<ul style="list-style-type: none"> ⚡⚡ Quite fast, more than 100 feet of borehole advancement per day is possible. ⚡⚡ Geophysical logs such as resistivity (which must be run in an uncased borehole) can be run before well construction. 	<ul style="list-style-type: none"> ⚡⚡ Potential cross-contamination of strata exposed to the circulating drilling fluid during drilling. ⚡⚡ Difficulty in removing mud residues during well development. ⚡⚡ Drilling mud may alter the groundwater chemistry by binding metals, sorbing organic compounds and by altering pH, cation exchange capacity and chemical oxidation demand of native fluids. ⚡⚡ Drilling mud may change local permeability of the formation.
Air Rotary	<ul style="list-style-type: none"> ⚡⚡ Like mud rotary method, more than 100 feet of borehole advancement a day is possible. ⚡⚡ Sampling different strata during drilling is possible if temporary casing is advanced. 	<ul style="list-style-type: none"> ⚡⚡ In contaminated formations, the use of high pressure air may pose a significant hazard to the drill crew due to rapid transport of contaminated material up the borehole during drilling. ⚡ Introduction of air to ground water could reduce concentration of volatile organic compounds locally.

thoroughly decontaminate the rig and all associated equipment to remove all oil, grease, mud, etc.

2. Before drilling each boring, steam-clean and rinse all the “down-the-hole” drill equipment with potable water to minimize cross-contamination. Special attention should be given to the thread section of the casings, and to the drill rods. All drilling equipment should be steam-cleaned at completion of the project to ensure that no contamination is transported to or from the sampling site.
3. Record lithologic descriptions and all field measurements and comments on the well log form (Appendix C). Include well construction diagrams on the well log form for each well installed. At a minimum, the well construction information should show depth from surface grade, the bottom of the boring, the screened interval, casing material, casing diameter, gravel pack location, grout seal and height of riser pipe above the ground. Also record the actual compositions of the grout and seal on the well log form.

4.7.3 Well Construction

The most commonly used casing materials include stainless steel, polyvinyl chloride (PVC) and Teflon. Monitoring wells are constructed with casings and materials that are resistant to the subsurface environment. The selection of well construction material is based on the material's long-term interaction with the contaminated groundwater. Construction materials should not cause an analytical bias in the interpretation of the chemical analysis of the water samples.

Well casing material should also be judged from a structural standpoint. Material should be rigid and nonporous, with a low surface-area-to-water ratio in the wellbore relative to the formation materials (U.S. EPA, 1987).

1. Fill the annular space between the well screen and the boring with a uniform gravel/sand pack to serve as a filter media. For wells deeper than approximately 50 feet, or when recommended by the site geologist, emplace the sand pack using a tremie pipe (normally consisting of a 1.25-inch PVC or steel pipe). Pump sand slurry composed of sand and

potable water through the tremie pipe into the annulus throughout the entire screened interval, and over the top of the screen. It is necessary to pump sufficient sand/gravel slurry to cover the screen after the sand/gravel pack has settled and become dense.

2. Determine the depth of the top of the sand using the tremie pipe, thus verifying the thickness of the sand pack. Add more sand to bring the top of the sand pack to approximately 2-3 feet above the top of the well screen. Under no circumstances should the sand pack extend into any aquifer other than the one to be monitored. In most cases, the well design can be modified to allow for a sufficient sand pack without threat of crossflow between producing zones through the sand pack.
3. In materials that will not maintain an open hole, withdraw the temporary or outer casing gradually during placement of sand pack/grout to the extent practical.

For example, after filling 2 feet with sand pack, the outer casing should be withdrawn 2 feet. This step of placing more gravel and withdrawing the outer casing should be repeated until the level of the sand pack is approximately 3 feet above the top of the well screen. This ensures that there is no locking of the permanent (inner) casing in the outer casing.

4. Emplace a bentonite seal, composed of pellets, between the sand pack and grout to prevent infiltration of cement into the filter pack and the well screen.

These pellets should have a minimum purity of 90% montmorillonite clay, and a minimum dry bulk density of 75 lb/ft³ for ½ inch pellets, as provided by American Colloid, or equivalent. Bentonite pellets shall be poured directly down the annulus.

Care must be taken to avoid introducing pellets into the well bore. A cap placed over the top of the well casing before pouring the bentonite pellets from the bucket will prevent this. To ensure even application, pour the pellets from different points around the casing. To avoid bridging of pellets, they should not be introduced at a rate faster than they can settle. A tremie pipe may be used to redistribute and

level out the top of the seal,

5. If using a slurry of bentonite as an annular seal, prepare it by mixing powdered or granular bentonite with potable water. The slurry must be of sufficiently high specific gravity and viscosity to prevent its displacement by the grout to be emplaced above it. As a precaution, regardless of depth, and depending on fluid viscosity, add a few handfuls of bentonite pellets to solidify the bentonite slurry surface.

6. Place a mixture of cement and bentonite grout from the top of the bentonite seal to the ground surface.

Only Type I or II cement without accelerator additives may be used. An approved source of potable water must be used for mixing grouting materials. The following mixes are acceptable:

- ⌘ Neat cement, a maximum of 6 gallons of water per 94-pound bag of cement
- ⌘⌘ Granular bentonite, 1.5 pounds of bentonite per 1 gallon of water
- ⌘⌘ Cement-bentonite, 5 pounds of pure bentonite per 94-pound bag of cement with 7-8 gallons of water; 13-14 pounds weight, if dry mixed
- ⌘ Cement-bentonite, 6 to 8 pounds of pure bentonite per 94-pound bag of cement with 8-10 gallons of water, if water mixed
- ⌘⌘ Non-expandable cement, mixed at 7.5 gallons of water to 1/2 teaspoon of aluminum hydroxide, 94 pounds of neat cement (Type I) and 4 pounds of bentonite
- ⌘ Non-expandable cement, mixed at 7 gallons of water to 1/2 teaspoon of aluminum hydroxide, 94 pounds of neat cement (Type I and Type II)

7. Pump grout through a tremie pipe to the bottom of the open annulus until undiluted grout flows from the annulus at the ground surface.
8. In materials that will not maintain an open hole, the temporary steel casing should be withdrawn in a manner that prevents the level

of grout from dropping below the bottom of the casing.

9. Additional grout may be added to compensate for the removal of the temporary casing and the tremie pipe to ensure that the top of the grout is at or above ground surface.

10. Place the protective casing. Protective casings should be installed around all monitoring wells. Exceptions are on a case-by-case basis. The minimum elements in the protection design include:

- ⌘ A protective steel cap to keep precipitation out of the protective casing, secured to the casing by padlocks.
- ⌘ A 5-foot-minimum length of black iron or galvanized pipe, extending about 1.5 to 3 feet above the ground surface, and set in cement grout. The pipe diameter should be 8 inches for 4-inch wells, and 6 inches for 2-inch wells (depending on approved borehole size). A 0.5-inch drain hole near ground level is permitted.
- ⌘ The installation of guard posts in addition to the protective casing, in areas where vehicular traffic may pose a hazard. These guard posts consist of 3-inch diameter steel posts or tee-bar driven steel posts. Groups of three are radially located 4 feet around each well 2 feet below and 4 feet above ground surface, with flagging in areas of high vegetation. Each post is cemented in place.
- ⌘⌘ A flush mount of protective casing may also be used in areas of high traffic or where access to other areas would be limited by a well with stickup.

After the grout sets (about 48 hours), fill any depression due to settlement with a grout mix similar to that described above.

4.0 CALCULATIONS

To maintain an open borehole using sand or water rotary drilling, the drilling fluid must exert a pressure greater than the formation pore pressure. Typical pore pressure for an unconfined aquifer is

0.433 psi/ft and for a confined aquifer is 0.465 psi/ft.

The calculation for determining the hydrostatic pressure of the drilling fluid is:

$$\text{Hydrostatic Pressure (psi)} = \text{Fluid Density (lb/gal)} \times \text{Height of Fluid Column (ft)} \times 0.052$$

The minimum grout volume necessary to grout a well can be calculated using:

$$\begin{aligned} \text{Grout Vol (ft}^3\text{)} &= \text{Vol of Borehole (ft}^3\text{)} - \text{Vol of Casing (ft}^3\text{)} \\ &= L (r_b^2 - r_c^2) \end{aligned}$$

where:

r_b = radius of boring (ft)
 r_c = radius of casing (ft)
 L = length of borehole to be grouted (ft)

4.9 QUALITY ASSURANCE/ QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures.

However, the following general QA procedures apply:

- All data must be documented on standard well completion forms, field data sheets or within field/site logbooks.
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

4.10 DATA VALIDATION

This section is not applicable to this SOP.

4.11 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and specific health and safety procedures.

5.0 WATER LEVEL MEASUREMENT: SOP #2151

5.1 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to set guidelines for the determination of the depth to water in an open borehole, cased borehole, monitoring well or piezometer.

Generally, water level measurements from boreholes, piezometers, or monitoring wells are used to construct water table or potentiometric surface maps. Therefore, all water level measurements at a given site should be collected within a 24-hour period. Certain situations may necessitate that all water level measurements be taken within a shorter time interval. These situations may include:

- the magnitude of the observed changes between wells appears too large
- atmospheric pressure changes
- aquifers which are tidally influenced
- aquifers affected by river stage, impoundments, and/or unlined ditches
- ◊ aquifers stressed by intermittent pumping of production wells
- ◊ aquifers being actively recharged due to precipitation events

5.2 METHOD SUMMARY

A survey mark should be placed on the casing for use as a reference point for measurement. Many times the lip of the riser pipe is not flat. Another measuring reference should be located on the grout apron. The measuring point should be documented in the site logbook and on the groundwater level data form (see Appendix C).

Water levels in piezometers and monitoring wells should be allowed to stabilize for a minimum of 24 hours after well construction and development, prior to measurement. In low yield situations, recovery may take longer.

Working with decontaminated equipment, proceed from the least to the most contaminated wells. Open the well and monitor headspace with the appropriate monitoring instrument to determine the presence of volatile organic compounds. Lower the water level measurement device into the well until water surface or bottom of casing is encountered. Measure distance from water surface to the reference point on the well casing and record in the site logbook and/or groundwater level data form. Remove all downhole equipment, decontaminate as necessary, and replace well casing cap.

5.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

This section is not applicable to this SOP.

5.4 INTERFERENCES AND POTENTIAL PROBLEMS

- The chalk used on steel tape may contaminate the well.
- ◊ Cascading water may obscure the water mark or cause it to be inaccurate.
- ◊ Many types of electric sounders use metal indicators at 5-foot intervals around a conducting wire. These intervals should be checked with a surveyor's tape to ensure accuracy.
- ◊ If there is oil present on the water, it can insulate the contacts of the probe on an electric sounder or give false readings due to thickness of the oil. Determining the thickness and density of the oil layer may be warranted, in order to determine the correct water level.
- Turbulence in the well and/or cascading water can make water level determination difficult with either an electric sounder or steel tape.

- ✍ An airline measures drawdown during pumping. It is only accurate to 0.5 foot unless it is calibrated for various “drawdowns”.

5.5 EQUIPMENT/APPARATUS

There are a number of devices which can be used to measure water levels, such as steel tape or airlines. The device should be adequate to attain an accuracy of 0.01 feet.

The following equipment is needed to measure water levels:

- ✍ air monitoring equipment
- ✍ water level measurement device
- ✍ electronic water level indicator
- ✍ metal tape measure
- ✍ airline
- ✍ steel tape
- ✍ chalk
- ✍ ruler
- ✍ notebook
- ✍ paper towels
- ✍ decontamination solution and equipment
- ✍ groundwater level data forms

5.6 REAGENTS

No chemical reagents are used in this procedure, with the exception of decontamination solutions. Where decontamination of equipment is required, refer to ERT SOP #2006, Sampling Equipment Decontamination and the site-specific work plan.

5.7 PROCEDURES

5.7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are needed.
2. Obtain necessary sampling and monitoring equipment.
3. Decontaminate or preclean equipment, and ensure that it is in working order.
4. Prepare scheduling and coordinate with staff,

clients, and regulatory agency, if appropriate.

5. Perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.
6. Identify and mark all sampling locations.

5.7.2 Procedures

1. Make sure water level measuring equipment is in good operating condition.
2. If possible and where applicable, start at those wells that are least contaminated and proceed to those wells that are most contaminated.
3. Clean all equipment entering the well by the following decontamination procedure:
 - Triple rinse equipment with deionized water.
 - Wash equipment with an Alconox solution followed by a deionized water rinse.
 - Rinse with an approved solvent (e.g., methanol, isopropyl alcohol, acetone) as per the work plan, if organic contamination is suspected.
 - Place equipment on clean surface such as a Teflon or polyethylene sheet.
4. Remove locking well cap, note location, time of day, and date in site notebook or an appropriate groundwater level data form.
5. Remove well casing cap.
6. If required by site-specific condition, monitor headspace of well with PID or PID to determine presence of volatile organic compounds and record in site logbook.
7. Lower electric water level measuring device or equivalent (i.e., permanently installed transducers or airline) into the well until water surface is encountered.
8. Measure the distance from the water surface to the reference measuring point on the well casing or protective barrier post and record in the field logbook. In addition, note that the

water level measurement was from the top of the steel casing, top of the PVC riser pipe, from the ground surface, or from some other position on the well head.

9. The groundwater level data form in Appendix C should be completed as follows:

- site name
- ✍ logger name: person taking field notes
- ✍ date: the date when the water levels are being measured
- ✍ location: monitor well number and physical location
- ✍ time: the military time at which the water level measurement was recorded
- ✍ depth to water: the water level measurement in feet, or in tenths or hundreds of feet, depending on the equipment used
- ✍ comments: any information the field personnel feels to be applicable
- measuring point: marked measuring point on PVC riser pipe, protective steel casing or concrete pad surrounding well casing from which all water level measurements for individual wells should be measured. This provides consistency in future water level measurements.

10. Measure total depth of well (at least twice to confirm measurement) and record in site notebook or on log form.
11. Remove all downhole equipment, replace well casing cap and lock steel caps.
12. Rinse all downhole equipment and store for transport to next well.
13. Note any physical changes such as erosion or cracks in protective concrete pad or variation in total depth of well in field notebook and on field data sheets.
14. Decontaminate all equipment as outlined in Step 3 above.

5.8 CALCULATIONS

To determine groundwater elevation above mean sea level, use the following equation:

$$E_w = E - D$$

where:

E_w = Elevation of water above mean sea level

E = Elevation above sea level at point of measurement

D = Depth to water

5.9 QUALITY ASSURANCE/ QUALITY CONTROL

The following general quality assurance procedures apply:

- All data must be documented on standard chain of custody forms, field data sheets or within personal/site logbooks.
- ✍ All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.
- Each well should be tested at least twice in order to compare results.

5.10 DATA VALIDATION

This section is not applicable to this SOP.

5.11 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and specific health and safety procedures.

6.0 WELL DEVELOPMENT: SOP #2156

6.1 SCOPE AND APPLICATION

The purpose of monitoring well development is to ensure removal of fines from the vicinity of the well screen. This allows free flow of water from the formation into the well and also reduces the turbidity of the water during sampling events. The most common well development methods are: surging, jetting, and overpumping.

Surging involves raising and lowering a surge block or surge plunger inside the well. The resulting motion surges water into the formation and loosens sediment to be pulled from the formation into the well. Occasionally, sediment must be removed from the well with a sand bailer to prevent sand locking of the surge block. This method may cause the sand pack around the screen to be displaced to a degree that damages its value as a filtering medium. For example, channels or voids may form near the screen if the filter pack sloughs away during surging (Keely and Boateng, 1987).

Jetting involves lowering a small diameter pipe into the well to a few feet above the well screen, and injecting water or air through the pipe under pressure so that sediments at the bottom are geysered out the top of the well. It is important not to jet air or water directly across the screen. This may cause fines in the well to be driven into the entrance of the screen openings thereby causing blockages.

Overpumping involves pumping at a rate rapid enough to draw the water level in the well as low as possible, and allowing it to recharge. This process is repeated until sediment-free water is produced. Overpumping is not as vigorous as surging and jetting and is probably the most desirable for monitoring well development.

6.2 METHOD SUMMARY

Development of a well should occur as soon as practical after installation, but not sooner than 48 hours after grouting is completed, if a rigorous well development is being used. If a less rigorous method, such as bailing, is used for development, it may be initiated shortly after installation. The main

concern is that the method being used for development does not interfere with allowing the grout to set.

Open the monitoring well, take initial measurements (e.g. head space air monitoring readings, water level, well depth, pH, temperature, and specific conductivity) and record results in the site logbook. Develop the well by the appropriate method (i.e., overpumping, jetting, or surging) to accommodate site conditions and project requirements. Continue until the developed water is clear and free of sediment. Containerize all discharge water from known or suspected contaminated areas. Record final measurements in the logbook. Decontaminate equipment as appropriate prior to use in the next well.

6.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

This section is not applicable to this Standard Operating Procedure (SOP).

6.4 INTERFERENCES AND POTENTIAL PROBLEMS

The following interferences or problems may occur during well development:

- ⚡ The possibility of disturbing the filter pack increases with surging and jetting well development methods.
- ⚡ The introduction of external water or air by jetting may alter the hydrochemistry of the aquifer.

6.5 EQUIPMENT/APPARATUS

The type of equipment used for well development is dependent on the diameter of the well. For example, submersible pumps cannot be used for well development unless the wells are 4 inches or greater in diameter, because the smallest

submersible pump has a 3 1/4 inch O.D.

In general, the well should be developed shortly after it is drilled. Most drilling rigs have air compressors or pumps that may be used for the development process.

6.6 REAGENTS

No chemical reagents are used in this procedure except for decontamination solutions. For guidelines on equipment decontamination, refer to ERT SOP #2006, Sampling Equipment Decontamination and the site-specific work plan.

6.7 PROCEDURES

6.7.1 Preparation

1. Coordinate site access and obtain keys to the monitoring well security cap locks.
2. Obtain information on each well to be developed (i.e., drilling, method, well diameter, depth, screened interval, anticipated contaminants, etc.).
3. Obtain a water level meter, air monitoring equipment, materials for decontamination, pH and electrical conductivity meters, a thermometer, and a stopwatch.
4. Assemble containers for temporary storage of water produced during well development. Containers must be structurally sound, compatible with anticipated contaminants, and easy to manage in the field. The use of truck-mounted tanks may be necessary in some cases; alternately, a portable water treatment unit (e.g. activated carbon) may be used to decontaminate the purge water.

6.7.2 Operation

The development should be performed as soon as practical after the well is installed, but no sooner than 48 hours after grouting is completed. Dispersing agents, acids, or disinfectants should not be used to enhance development of the well.

1. Assemble necessary equipment on a plastic sheet around the well.
2. Record pertinent information in field logbook (personnel, time, location ID, etc.).
3. Open monitoring well, and take air monitoring readings at the top of casing and in the breathing zone as appropriate.
4. Measure depth to water and the total depth of the monitoring well from the same datum point.
5. Measure the initial pH, temperature, and specific conductivity of the water and record in the logbook.
6. Develop the well until the water is clear and appears to be free of sediment. Note the initial color, clarity and odor of the water.
7. All water produced by development in contaminated or suspected contaminated areas must be containerized or treated. Clearly label each container with the location ID. Determination of the appropriate disposal method will be based on the fast round of analytical results from each well.
8. No water should be added to the well to assist development without prior approval by the site geologist. If a well cannot be cleaned of mud to produce formation water because the aquifer yields insufficient water, small amounts of potable water may be injected to clean up this poorly yielding well. This may be done by dumping in buckets of water. When most of the mud is out, continue development with formation water only. It is essential that at least live times the amount of water injected must be produced back from the well in order to ensure that all injected water is removed from the formation.
9. Note the final color, clarity and odor of the water.
10. Measure the final pH, temperature and specific conductance of the water and record in the field logbook.
11. Record the following data in the field logbook:
 - ✍ well designation (location ID)
 - ✍ date(s) of well installation
 - ✍ date(s) and time of well development
 - ✍ static water level before and after

- development
- ☞ quantity of water removed and time of removal
- ☞ type and size/capacity of pump and/or bailer used
- ☞ description of well development techniques used

6.7.3 Post Operation

1. Decontaminate all equipment.
2. Store containers of purge water produced during development in a safe and secure area.
3. After the first round of analytical results have been received, determine and implement the appropriate purge water disposal method.

6.8 CALCULATIONS

There are no calculations necessary to implement this procedure. However, if it is necessary to calculate the volume of the well, utilize the following equation:

$$\text{Well volume} = nr^2h(cf) \quad [\text{Equation 1}]$$

where:

- n** = pi
- r** = radius of monitoring well (feet)
- h** = height of the water column (feet)
[This may be determined by subtracting the depth to water from the total depth of the well as measured from the same reference point.]
- cf** = conversion factor (gal/ft³) = 7.48 gal/ft³ [In this equation, 7.48 gal/ft³ is the necessary conversion factor, because 7.48 gallons of water occupy 1 ft³]

Monitoring wells are typically 2 inches, 3 inches, 4 inches, or 6 inches in diameter. If the diameter of the monitoring well is known, a number of standard conversion factors can be used to simplify the equation above.

The volume, in gallons per linear foot, for various standard monitoring well diameters can be calculated as follows:

$$v = nr^2(cf) \quad [\text{Equation 2}]$$

where:

- v** = volume in gallons per linear foot
- n** = pi
- r** = radius of monitoring well (feet)
- cf** = conversion factor (7.48 gal/ft³)

For a 2-inch diameter well, the volume per linear foot can be calculated as follows:

$$\begin{aligned} v &= nr^2(cf) \quad [\text{Equation 2}] \\ &= 3.14 (1/12 \text{ ft})^2 7.48 \text{ gal/ft}^3 \\ &= 0.1632 \text{ gal/ft} \end{aligned}$$

Remember that if you have a 2-inch diameter well, you must convert this to the radius in feet to be able to use the equation.

The volume per linear foot for monitoring wells of common size are as follows:

<u>Well diameter</u>	<u>v (volume in gal/ft.)</u>
2-inch	0.1632
3-inch	0.3672
4-inch	0.6528
6-inch	1.4688

If you utilize the factors above, Equation 1 should be modified as follows:

$$\text{Well volume} = h(v) \quad [\text{Equation 3}]$$

where:

- h** = height of water column (feet)
- v** = volume in gallons per linear foot from Equation 2

6.9 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following general QA procedures apply:

- ☞ All data must be documented on standard chain of custody forms, field data sheets or personal/site logbooks.
- ☞ All instrumentation must be operated in accordance with operating instructions as

supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

6.10 DATA VALIDATION

This section is not applicable to this SOP

6.11 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and specific health and safety procedures.

7.0 CONTROLLED PUMPING TEST: SOP #2157

7.1 SCOPE AND APPLICATION

The most reliable and commonly used method of determining aquifer characteristics is by controlled aquifer pumping tests. Groundwater flow varies in space and time and depends on the hydraulic properties of the rocks and the boundary conditions imposed on the groundwater system. Pumping tests provide results that are more representative of aquifer characteristics than those predicted by slug or bailer tests. Pumping tests require a greater degree of activity and expense, however, and are not always justified for all levels of investigation. For example, slug tests may be acceptable at the reconnaissance level whereas pumping tests are usually performed as part of a feasibility study in support of designs for aquifer remediation.

Aquifer characteristics which may be learned using pumping tests include hydraulic conductivity (K), transmissivity (T), specific yield (Sy) for unconfined aquifers, and storage coefficient (S) for confined aquifers. These parameters can be determined by graphical solutions and computerized programs. This Standard Operating Procedure (SOP) outlines the protocol for conducting controlled pumping tests.

7.2 METHOD SUMMARY

It is desirable to monitor pre-test water levels at the test site for about 1 week prior to performance of the pump test. This information allows for the determination of the barometric efficiency of the aquifer, as well as noting changes in head, due to recharging or pumping in the area adjacent to the well. Prior to initiating the long term pump test, a step test is conducted to estimate the greatest flow rate that may be sustained by the pump well.

After the pumping well has recovered from the step test, the long term pumping test begins. At the beginning of the test, the discharge rate is set as quickly and accurately as possible. The water levels in the pumping well and observation wells are recorded accordingly with a set schedule. Data is entered on the Pump/Recovery Test Data Sheet (Appendix C). The duration of the test is determined by project needs and aquifer

properties, but rarely goes beyond 3 days or until water levels become constant.

7.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

This section is not applicable to this SOP.

7.4 INTERFERENCES AND POTENTIAL PROBLEMS

Interferences and potential problems include:

- atmospheric conditions
- impact of local potable wells
- compression of the aquifer due to trains, heavy traffic, etc.

7.5 EQUIPMENT/APPARATUS

- tape measure (subdivided into tenths of feet)
- submersible pump
- water pressure transducer
- electric water level indicator
- weighted tapes
- steel tape (subdivided into tenths of feet)
- generator
- electronic data-logger (if transducer method is used)
- watch or stopwatch with second hand
- semilogarithmic graph paper (if required)
- water proof ink pen and logbook
- thermometer
- appropriate references and calculator
- a barometer or recording barograph (for tests conducted in confined aquifers)
- heat shrinks
- electrical tape
- flashlights and lanterns
- pH meter
- conductivity meter
- discharge pipe
- flow meter

7.6 REAGENTS

No chemical reagents are used for this procedure; however, decontamination solutions may be necessary. If decontamination of equipment is required, refer to ERT SOP #2006, Sampling Equipment Decontamination and the site-specific work plan.

7.7 PROCEDURES

7.7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are needed.
2. Obtain necessary sampling and monitoring equipment.
3. Decontaminate or preclean equipment, and ensure that it is in working order.
4. Prepare scheduling and coordinate with staff, clients, and regulatory agency, if appropriate.
5. Perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.
6. Identify and mark all sampling locations.

7.7.2 Field Preparation

1. Review the site work plan and become familiar with information on the wells to be tested.
2. Check and ensure the proper operation of all field equipment. Ensure that the electronic data-logger is fully charged, if appropriate. Test the electronic data-logger using a container of water. Always bring additional transducers in case of malfunctions.
3. Assemble a sufficient number of field data forms to complete the field assignment.
4. Develop the pumping well prior to testing, per ERT SOP #2156, Well Development.
5. Provide an orifice, weir, flow meter, container or other type of water measuring device to accurately measure and monitor the discharge

from the pumping well.

6. Provide sufficient pipe to transport the discharge from the pumping well to an area beyond the expected cone of depression. Conducting a pumping test in contaminated groundwater may require treatment, special handling, or a discharge permit before the water can be discharged.
7. The discharge pipe must have a gate valve to control the pumping rate.
8. Determine if there is an outlet near the well head for water quality determination and sampling.

7.7.3 Pre-Test Monitoring

It is desirable to monitor pretest water levels at the test site for about 1 week prior to performance of the test. This can be accomplished by using a continuous-recording device such as a Stevens recorder. This information allows the determination of the barometric efficiency of the aquifer when barometric records are available. It also helps determine if the aquifer is experiencing an increase or decrease in head with time due to recharge or pumping in the nearby area, or diurnal effects of evapotranspiration. Changes in barometric pressure are recorded during the test (preferably with an on-site barograph) in order to correct water levels for any possible fluctuations which may occur due to changing atmospheric conditions. Pretest water level trends are projected for the duration of the test. These trends and/or barometric changes are used to “correct” water levels during the test so they are representative of the hydraulic response of the aquifer due to pumping of the test well.

7.7.4 Step Test

Conduct a step test prior to initiating a long term pumping test. The purpose of a step test is to estimate the greatest flow rate that may be sustained during a long term test. The test is performed by progressively increasing the flow rate at 1 hour intervals. The generated drawdown versus time data is plotted on semilogarithmic graph paper, and the discharge rate is determined from this graph.

7.7.5 Pump Test

Time Intervals

After the pumping well has fully recovered from the step test, the long term pumping test may start. At the beginning of the test, the discharge rate should be set as quickly and accurately as possible. The water levels in the pumping well and observation wells will be recorded according to Tables 4 and 5 below.

Water Level Measurements

Water levels will be measured as specified in ERT SOP #2151, Well Level Measurement. During the early part of the test, sufficient personnel should be

available to have at least one person at each observation well and at the pumping well. After the first 2 hours, two people are usually sufficient to continue the test. It is not necessary that readings at the wells be taken simultaneously. It is very important that depth to water readings be measured accurately and readings recorded at the exact time measured. Alternately, individual pressure transducers and electronic data-loggers may be used to reduce the number of field personnel hours required to complete the pumping test. A typical aquifer pump test form is shown in Appendix C.

During a pumping test, the following data must be recorded accurately on the aquifer test data form.

1. Site ID -- A number assigned to identity a specific site.

Table 4: Time Intervals for Measuring Drawdown in the Pumped Well

Elapsed Time From Start of Test (Minutes)	Interval Between Measurements (Minutes)
0 - 10	0.5 - 1
10 - 15	1
15 - 60	5
60-300	30
300-1440	60
1440 - termination	480

Table 5: Time Intervals for Measuring Drawdown in an Observation Well

Elapsed Time From Start of Test (Minutes)	Interval Between Measurements (Minutes)
O-60	2
60 - 120	5
120 - 240	10
240 - 360	30
360-1440	60
1440 - termination	480

2. Location -- The location of the well in which water level measurements are being taken.
3. Distance from Pumped Well -- Distance between the observation well and the pumping well in feet.
4. Logging Company -- The company conducting the pumping test.
5. Test Start Date -- The date when the pumping test began.
6. Test Start Time -- Start time, using a 24hour clock.
7. Static Water Level (Test Start) -- Depth to water, in feet and tenths of feet, in the observation well at the beginning of the pumping test.
8. Test End Date -- The date when the pumping test was completed.
9. Test End Time -- End time, using a 24hour clock.
10. Static Water Level (Test End) -- Depth to water, in feet and tenths of feet, in the observation well at the end of the pumping test.
11. Average Pumping Rate -- Summation of all entries recorded in the Pumping Rate (gal/min) column divided by the total number of Pumping Rate (gal/min) readings.
12. Measurement Methods -- Type of instrument used to measure depth-to-water (this may include steel tape, electric sounding probes, Stevens recorders, or pressure transducers).
13. Comments -- Appropriate observations or information which have not been recorded elsewhere, including notes on sampling.
14. Elapsed Time (min) -- Time of measurement recorded continuously from start of test (time 00.00).
15. Depth to Water (ft) -- Depth to water, in feet and tenths of feet, in the observation well at the time of the water level measurement.
16. Pumping Rate (gal/min) -- Flow rate of pump measured from an orifice, weir, flow meter,

container or other type of water-measuring device.

Test Duration

The duration of the test is determined by the needs of the project and properties of the aquifer. One simple test for determining adequacy of data is when the log-time versus drawdown for the most distant observation well begins to plot as a straight line on the semilogarithmic graph paper. There are several exceptions to this simple rule of thumb, therefore, it should be considered a minimum criterion. Different hydrogeologic conditions can produce straight line trends on log-time versus drawdown plots. In general, longer tests produce more definitive results. A duration of 1 to 3 days is desirable, followed by a similar period of monitoring the recovery of the water level. Unconfined aquifers and partially penetrating wells may have shorter test durations. Knowledge of the local hydrogeology, combined with a clear understanding of the overall project objectives, is necessary in interpreting just how long the test should be conducted. There is no need to continue the test if the water level becomes constant with time. This normally indicates that a hydrogeologic source has been intercepted and that additional useful information will not be collected by continued pumping.

7.7.6 Post Operation

1. After completion of water level recovery measurements, decontaminate and/or dispose of equipment as per ERT SOP #2006, Sampling Equipment Decontamination.
2. When using an electronic data-logger, use the following procedures.
 - ⌘ Stop logging sequence.
 - ⌘ Print data, or save memory and disconnect battery at the end of the day's activities.
3. Replace testing equipment in storage containers.
4. Check sampling equipment and supplies. Repair or replace all broken or damaged equipment.
5. Review field forms for completeness.

6. Interpret pumping/recovery test field results.

7.8 CALCULATIONS

There are several accepted methods for determining aquifer properties such as transmissivity, storativity, and conductivity. However, the method to use is dependent on the characteristics of the aquifer being tested (confined, unconfined, leaky confining layer, etc.). When reviewing pump test data, texts by Fetter, or Driscoll or Freeze and Cherry may be used to determine the method most appropriate to your case. See the reference section on page 69.

7.9 QUALITY ASSURANCE/ QUALITY CONTROL

Calibrate all gauges, transducers, flow meters, and other equipment used in conducting pumping tests before use at the site.

Obtain records of the instrument calibration and file with the test data records. The calibration records will consist of laboratory measurements. If necessary, perform any on-site zero adjustment and/or calibration. Where possible, check all flow and measurement meters on-site using a container of measured volume and stopwatch; the accuracy of the meters must be verified before testing proceeds.

7.10 DATA VALIDATION

This section is not applicable to this SOP.

7.11 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and specific health and safety procedures.

8.0 SLUG TEST: SOP #2158

8.1 SCOPE AND APPLICATION

This procedure can determine the horizontal hydraulic conductivity of distinct geologic horizons under in situ conditions. The hydraulic conductivity (K) is an important parameter for modeling the flow of groundwater in an aquifer.

8.2 METHOD SUMMARY

A slug test involves the instantaneous injection of a slug (a solid cylinder of known volume) or withdrawal of a volume of water. A slug displaces a known volume of water from a well and measures the artificial fluctuation of the groundwater level.

There are several advantages to using slug tests to estimate hydraulic conductivities. First, estimates can be made in situ, thereby avoiding errors incurred in laboratory testing of disturbed soil samples. Second, compared with pump tests, slug tests can be performed quickly and at relatively low cost, because pumping and observation wells are not required. And last, the hydraulic conductivity of small discrete portions of an aquifer can be estimated (e.g., sand layers in a clay).

8.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

This section is not applicable to this Standard Operating Procedure (SOP).

8.4 INTERFERENCES AND POTENTIAL PROBLEMS

- ⚡ Only the hydraulic conductivity of the area immediately surrounding the well is estimated, which may not be representative of the average hydraulic conductivity of the area.
- ⚡ The storage coefficient, S, usually cannot be determined by this method.

8.5 EQUIPMENT/APPARATUS

The following equipment is needed to perform slug tests. All equipment which comes in contact with the well should be decontaminated and tested prior to commencing field activities.

- tape measure (subdivided into tenths of feet)
- water pressure transducer
- electric water level indicator
- weighted tapes
- steel tape (subdivided into tenths of feet)
- electronic data-logger (if transducer method is used)
- stainless steel slug of a known volume
- watch or stopwatch with second hand
- semilogarithmic graph paper (if required)
- waterproof ink pen and logbook
- thermometer
- appropriate references and calculator
- electrical tape
- 21X micrologger
- Compaq portable computer or equivalent with Grapher installed on the hard disk

8.6 REAGENTS

No chemical reagents are used in this procedure; however, decontamination solvents may be necessary. When decontaminating the slug or equipment, refer to ERT SOP #2006, Sampling Equipment Decontamination, and the site-specific work plan.

8.7 PROCEDURES

8.7.1 Field Procedures

When the slug test is performed using an electronic data-logger and pressure transducer, all data will be stored internally or on computer diskettes or tape. The information will be transferred directly to the main computer and analyzed. Keep a computer printout of the data in the files as documentation.

If the slug test data is collected and recorded manually, the slug test data form (Appendix C) will

be used to record observations. The slug test data form should include the following information:

- site ID -- identification number assigned to the site
- location ID -- identification of location being tested
- date -- the date when the test data were collected in this order: year, month, day (e.g., 900131 for January 31, 1990)
- slug volume (ft³) = manufacturer's specification for the known volume or displacement of the slug device
- logger -- identifies the company or person responsible for performing the field measurements
- test method -- the slug device either is injected or lowered into the well, or is withdrawn or pulled-out from the monitor well. Check the method that is applicable to the test situation being run.
- comments -- appropriate observations or information for which no other blanks are provided.
- elapsed time (minutes) -- cumulative time readings from beginning of test to end of test, in minutes
- depth to water (feet) -- depth to water recorded in tenths of feet

The following general procedures may be used to collect and report slug test data. These procedures may be modified to reflect site-specific conditions:

1. Decontaminate the transducer and cable.
2. Make initial water level measurements on monitoring **wells** in an upgradient-to-downgradient sequence, if possible, to minimize the potential for cross-contamination.
3. Before beginning the slug test, record information into the electronic data-logger. The type of information may vary depending on the model used. When using different model, consult the operator's manual for the proper data entry sequence to be used.
4. Test wells from least contaminated to most contaminated, if possible.
5. Determine the static water level in the well by measuring the depth to water periodically for several minutes and taking the average of the readings, (see SOP #2151, Water Level

Measurement).

6. Cover sharp edges of the well casing with duct tape to protect the transducer cables.
7. Install the transducer and cable in the well to a depth below the target drawdown estimated for the test but at least 2 feet from the bottom of the well. Be sure the depth of submergence is within the design range stamped on the transducer. Temporarily tape the transducer cable to the well to keep the transducer at a constant depth.
8. Connect the transducer cable to the electronic data-logger.
9. Enter the initial water level and transducer design range into the recording device according to the manufacturer's instructions. The transducer design range will be stamped on the side of the transducer. Record the initial water level on the recording device.
10. "Instantaneously" introduce or remove a known volume or slug of water to the well. Another method is to introduce a solid cylinder of known volume to displace and raise the water level, allow the water level to restabilize and remove the cylinder. It is important to remove or add the volumes as quickly as possible because the analysis assumes an "instantaneous" change in volume is created in the well.
11. Consider the moment of volume addition or removal as time zero. Measure and record the depth to water and the time at each reading. Depths should be measured to the nearest 0.01 foot. The number of depth-time measurements necessary to complete the test is variable. It is critical to make as many measurements as possible in the early part of the test. The number and intervals between measurements will be determined from previous aquifer tests or evaluations.
12. Continue measuring and recording depth-time measurements until the water level returns to equilibrium conditions or a sufficient number of readings have been made to clearly show a trend on a semilogarithmic plot of time versus depth.
13. Retrieve slug (if applicable).

Note: The time required for a slug test to be completed is a function of the volume of the slug, the hydraulic conductivity of the formation and the type of well completion. The slug volume should be large enough that a sufficient number of water level measurements can be made before the water level returns to equilibrium conditions. The length of the test may range from less than a minute to several hours. If the well is to be used as a monitoring well, precautions against contaminating it should be taken. If water is added to the monitoring well, it should be from an uncontaminated source and transported in a clean container. Bailers or measuring devices should be decontaminated prior to the test. If tests are performed on more than one monitoring well, care must be taken to avoid cross-contamination of the wells.

Slug tests should be conducted on relatively undisturbed wells. If a test is conducted on a well that has recently been pumped for water sampling purposes, the measured water level must be within 0.1 foot of the static water level prior to sampling. At least 1 week should elapse between the drilling of a well and the performance of a slug test.

8.7.2 Post Operation

When using an electronic data-logger, use the following procedure:

1. Stop logging sequence.
2. Print data.
3. Send data to computer by telephone.
4. Save memory and disconnect battery at the end of the day's activities.
5. Review field forms for completeness.

8.8 CALCULATIONS

The simplest interpretation of piezometer recovery is that of Hvorslev (1951). The analysis assumes a homogenous, isotropic medium in which soil and water are incompressible. Hvorslev's expression for hydraulic conductivity (K) is:

$$K = \frac{r^2 \ln(L/R)}{2LT_0}$$

for $L/R > 8$

where:

- K = hydraulic conductivity [feet/second]
- r = casing radius [feet]
- L = length of open screen (or open borehole) [feet]
- R = filter pack (borehole) radius [feet]
- T₀ = Basic Time Lag [seconds]; value of t on semilogarithmic plot of (H-h)/(H-H₀) vs. t, when (H-h)/(H-H₀) = 0.37

where:

- H = initial water level prior to removal of slug
- H₀ = water level at t = 0
- h = recorded water level at t > 0

(Hvorslev, 1951; Freeze and Cherry, 1979)

The Bower and Rice method is also commonly used for K calculations. However, it is much more time consuming than the Hvorslev method. Refer to Freeze and Cherry or Fetter for a discussion of these methods.

8.9 QUALITY ASSURANCE/ QUALITY CONTROL

The following general quality assurance procedures apply:

- ≪ All data must be documented on standard chain of custody forms, field data sheets, or within personal/site logbooks.
- ≪≪ All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

The following specific quality assurance activity will apply:

- ≪ Each well should be tested at least twice in order to compare results.

8.10 DATA VALIDATION

This section is not applicable to this SOP.

8.11 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and specific health and safety procedures.

APPENDIX A

Sampling Train Schematic

Figure 1: Sampling Train Schematic

SOP #2149

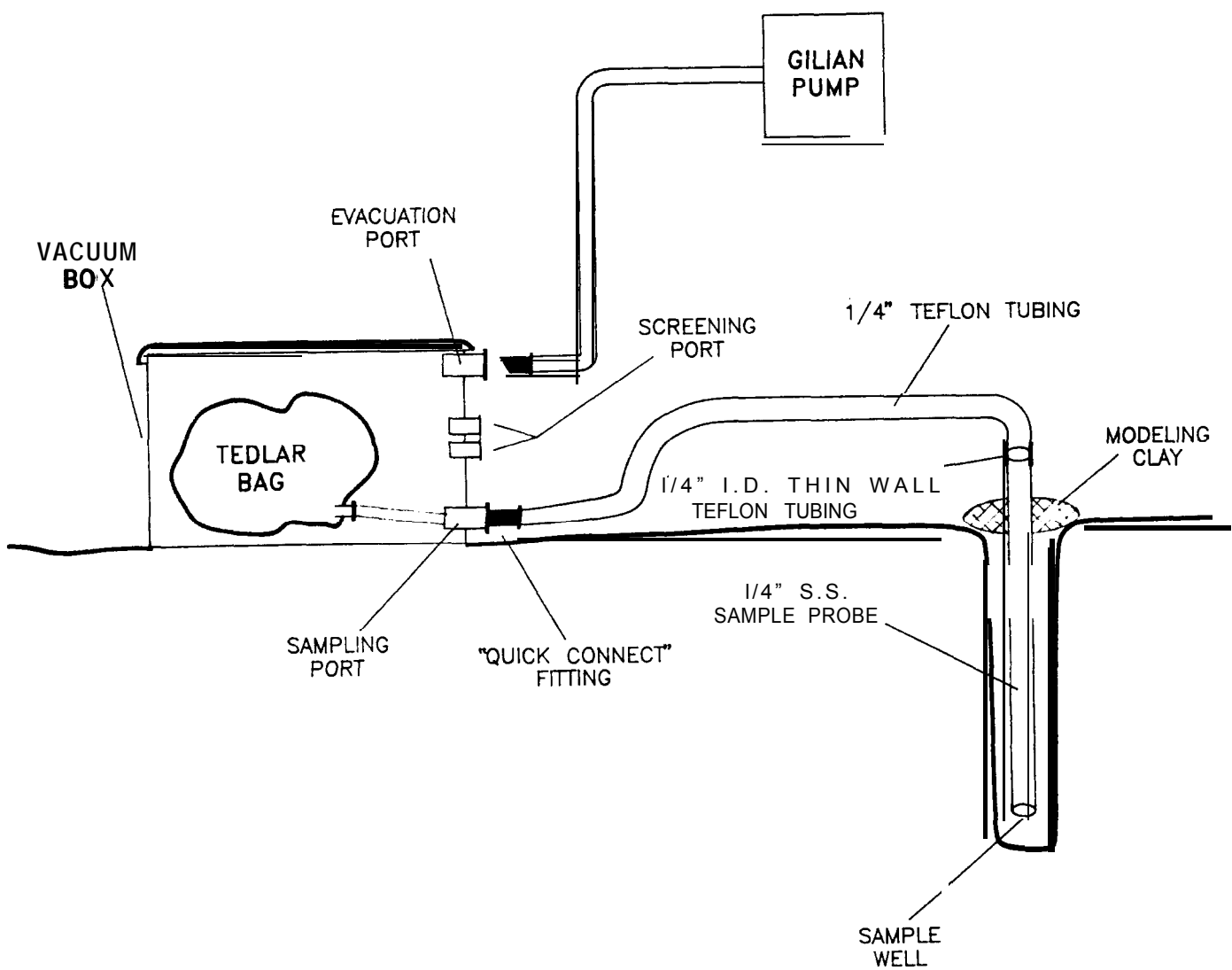
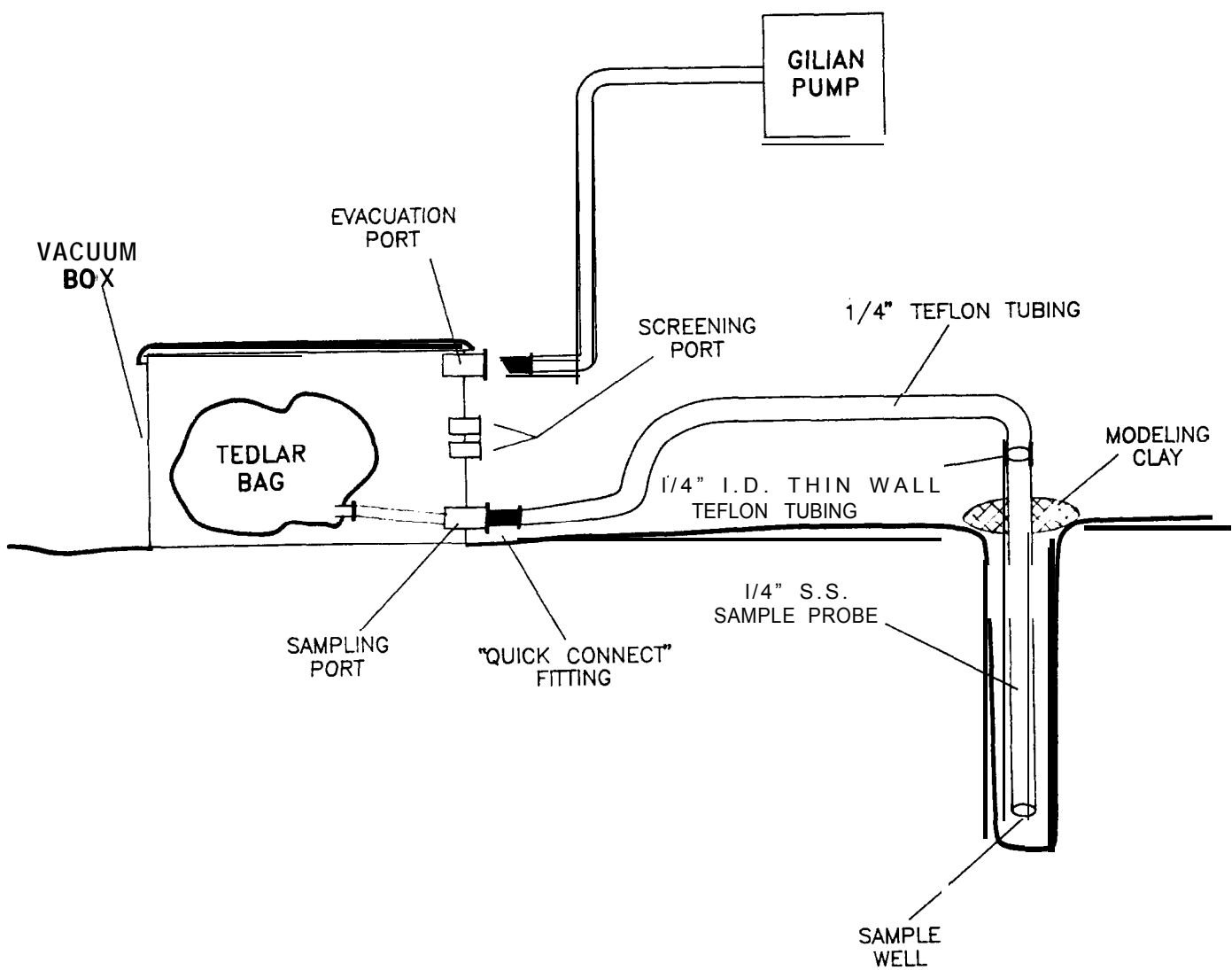


Figure 1: Sampling Train Schematic

SOP #2149



APPENDIX A

Sampling Train Schematic

8.10 DATA VALIDATION

This section is not applicable to this SOP.

8.11 HEALTH AND SAFETY

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8.11 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and specific health and safety procedures.

Note: The time required for a slug test to be completed is a function of the volume of the slug, the hydraulic conductivity of the formation and the type of well completion. The slug volume should be large enough that a sufficient number of water level measurements can be made before the water level returns to equilibrium conditions. The length of the test may range from less than a minute to several hours. If the well is to be used as a monitoring well, precautions against contaminating it should be taken. If water is added to the monitoring well, it should be from an uncontaminated source and transported in a clean container. Bailers or measuring devices should be decontaminated prior to the test. If tests are performed on more than one monitoring well, care must be taken to avoid cross-contamination of the wells.

Slug tests should be conducted on relatively undisturbed wells. If a test is conducted on a well that has recently been pumped for water sampling purposes, the measured water level must be within 0.1 foot of the static water level prior to sampling. At least 1 week should elapse between the drilling of a well and the performance of a slug test.

8.7.2 Post Operation

When using an electronic data-logger, use the following procedure:

1. Stop logging sequence.
2. Print data.
3. Send data to computer by telephone.
4. Save memory and disconnect battery at the end of the day's activities.
5. Review field forms for completeness.

8.8 CALCULATIONS

The simplest interpretation of piezometer recovery is that of Hvorslev (1951). The analysis assumes a homogenous, isotropic medium in which soil and water are incompressible. Hvorslev's expression for hydraulic conductivity (K) is:

$$K = \frac{r^2 \ln(L/R)}{2LT_0}$$

for $L/R > 8$

where:

- K = hydraulic conductivity [feet/second]
- r = casing radius [feet]
- L = length of open screen (or open borehole) [feet]
- R = filter pack (borehole) radius [feet]
- T₀ = Basic Time Lag [seconds]; value of t on semilogarithmic plot of (H-h)/(H-H₀) vs. t, when (H-h)/(H-H₀) = 0.37

where:

- H = initial water level prior to removal of slug
- H₀ = water level at t = 0
- h = recorded water level at t > 0

(Hvorslev, 1951; Freeze and Cherry, 1979)

The Bower and Rice method is also commonly used for K calculations. However, it is much more time consuming than the Hvorslev method. Refer to Freeze and Cherry or Fetter for a discussion of these methods.

8.9 QUALITY ASSURANCE/ QUALITY CONTROL

The following general quality assurance procedures apply:

- ≪ All data must be documented on standard chain of custody forms, field data sheets, or within personal/site logbooks.
- ≪≪ All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

The following specific quality assurance activity will apply:

- ≪ Each well should be tested at least twice in order to compare results.

be used to record observations. The slug test data form should include the following information:

- site ID -- identification number assigned to the site
- location ID -- identification of location being tested
- date -- the date when the test data were collected in this order: year, month, day (e.g., 900131 for January 31, 1990)
- slug volume (ft³) = manufacturer's specification for the known volume or displacement of the slug device
- logger -- identifies the company or person responsible for performing the field measurements
- test method -- the slug device either is injected or lowered into the well, or is withdrawn or pulled-out from the monitor well. Check the method that is applicable to the test situation being run.
- comments -- appropriate observations or information for which no other blanks are provided.
- elapsed time (minutes) -- cumulative time readings from beginning of test to end of test, in minutes
- depth to water (feet) -- depth to water recorded in tenths of feet

The following general procedures may be used to collect and report slug test data. These procedures may be modified to reflect site-specific conditions:

1. Decontaminate the transducer and cable.
2. Make initial water level measurements on monitoring **wells** in an upgradient-to-downgradient sequence, if possible, to minimize the potential for cross-contamination.
3. Before beginning the slug test, record information into the electronic data-logger. The type of information may vary depending on the model used. When using different model, consult the operator's manual for the proper data entry sequence to be used.
4. Test wells from least contaminated to most contaminated, if possible.
5. Determine the static water level in the well by measuring the depth to water periodically for several minutes and taking the average of the readings, (see SOP #2151, Water Level

Measurement).

6. Cover sharp edges of the well casing with duct tape to protect the transducer cables.
7. Install the transducer and cable in the well to a depth below the target drawdown estimated for the test but at least 2 feet from the bottom of the well. Be sure the depth of submergence is within the design range stamped on the transducer. Temporarily tape the transducer cable to the well to keep the transducer at a constant depth.
8. Connect the transducer cable to the electronic data-logger.
9. Enter the initial water level and transducer design range into the recording device according to the manufacturer's instructions. The transducer design range will be stamped on the side of the transducer. Record the initial water level on the recording device.
10. "Instantaneously" introduce or remove a known volume or slug of water to the well. Another method is to introduce a solid cylinder of known volume to displace and raise the water level, allow the water level to restabilize and remove the cylinder. It is important to remove or add the volumes as quickly as possible because the analysis assumes an "instantaneous" change in volume is created in the well.
11. Consider the moment of volume addition or removal as time zero. Measure and record the depth to water and the time at each reading. Depths should be measured to the nearest 0.01 foot. The number of depth-time measurements necessary to complete the test is variable. It is critical to make as many measurements as possible in the early part of the test. The number and intervals between measurements will be determined from previous aquifer tests or evaluations.
12. Continue measuring and recording depth-time measurements until the water level returns to equilibrium conditions or a sufficient number of readings have been made to clearly show a trend on a semilogarithmic plot of time versus depth.
13. Retrieve slug (if applicable).

8.0 SLUG TEST: SOP #2158

8.1 SCOPE AND APPLICATION

This procedure can determine the horizontal hydraulic conductivity of distinct geologic horizons under in situ conditions. The hydraulic conductivity (K) is an important parameter for modeling the flow of groundwater in an aquifer.

8.2 METHOD SUMMARY

A slug test involves the instantaneous injection of a slug (a solid cylinder of known volume) or withdrawal of a volume of water. A slug displaces a known volume of water from a well and measures the artificial fluctuation of the groundwater level.

There are several advantages to using slug tests to estimate hydraulic conductivities. First, estimates can be made in situ, thereby avoiding errors incurred in laboratory testing of disturbed soil samples. Second, compared with pump tests, slug tests can be performed quickly and at relatively low cost, because pumping and observation wells are not required. And last, the hydraulic conductivity of small discrete portions of an aquifer can be estimated (e.g., sand layers in a clay).

8.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

This section is not applicable to this Standard Operating Procedure (SOP).

8.4 INTERFERENCES AND POTENTIAL PROBLEMS

- ⚡ Only the hydraulic conductivity of the area immediately surrounding the well is estimated, which may not be representative of the average hydraulic conductivity of the area.
- ⚡ The storage coefficient, S, usually cannot be determined by this method.

8.5 EQUIPMENT/APPARATUS

The following equipment is needed to perform slug tests. All equipment which comes in contact with the well should be decontaminated and tested prior to commencing field activities.

- tape measure (subdivided into tenths of feet)
- water pressure transducer
- electric water level indicator
- weighted tapes
- steel tape (subdivided into tenths of feet)
- electronic data-logger (if transducer method is used)
- stainless steel slug of a known volume
- watch or stopwatch with second hand
- semilogarithmic graph paper (if required)
- waterproof ink pen and logbook
- thermometer
- appropriate references and calculator
- electrical tape
- 21X micrologger
- Compaq portable computer or equivalent with Grapher installed on the hard disk

8.6 REAGENTS

No chemical reagents are used in this procedure; however, decontamination solvents may be necessary. When decontaminating the slug or equipment, refer to ERT SOP #2006, Sampling Equipment Decontamination, and the site-specific work plan.

8.7 PROCEDURES

8.7.1 Field Procedures

When the slug test is performed using an electronic data-logger and pressure transducer, all data will be stored internally or on computer diskettes or tape. The information will be transferred directly to the main computer and analyzed. Keep a computer printout of the data in the files as documentation.

If the slug test data is collected and recorded manually, the slug test data form (Appendix C) will

6. Interpret pumping/recovery test field results.

7.8 CALCULATIONS

There are several accepted methods for determining aquifer properties such as transmissivity, storativity, and conductivity. However, the method to use is dependent on the characteristics of the aquifer being tested (confined, unconfined, leaky confining layer, etc.). When reviewing pump test data, texts by Fetter, or Driscoll or Freeze and Cherry may be used to determine the method most appropriate to your case. See the reference section on page 69.

7.9 QUALITY ASSURANCE/ QUALITY CONTROL

Calibrate all gauges, transducers, flow meters, and other equipment used in conducting pumping tests before use at the site.

Obtain records of the instrument calibration and file with the test data records. The calibration records will consist of laboratory measurements. If necessary, perform any on-site zero adjustment and/or calibration. Where possible, check all flow and measurement meters on-site using a container of measured volume and stopwatch; the accuracy of the meters must be verified before testing proceeds.

7.10 DATA VALIDATION

This section is not applicable to this SOP.

7.11 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and specific health and safety procedures.

2. Location -- The location of the well in which water level measurements are being taken.
3. Distance from Pumped Well -- Distance between the observation well and the pumping well in feet.
4. Logging Company -- The company conducting the pumping test.
5. Test Start Date -- The date when the pumping test began.
6. Test Start Time -- Start time, using a 24hour clock.
7. Static Water Level (Test Start) -- Depth to water, in feet and tenths of feet, in the observation well at the beginning of the pumping test.
8. Test End Date -- The date when the pumping test was completed.
9. Test End Time -- End time, using a 24hour clock.
10. Static Water Level (Test End) -- Depth to water, in feet and tenths of feet, in the observation well at the end of the pumping test.
11. Average Pumping Rate -- Summation of all entries recorded in the Pumping Rate (gal/min) column divided by the total number of Pumping Rate (gal/min) readings.
12. Measurement Methods -- Type of instrument used to measure depth-to-water (this may include steel tape, electric sounding probes, Stevens recorders, or pressure transducers).
13. Comments -- Appropriate observations or information which have not been recorded elsewhere, including notes on sampling.
14. Elapsed Time (min) -- Time of measurement recorded continuously from start of test (time 00.00).
15. Depth to Water (ft) -- Depth to water, in feet and tenths of feet, in the observation well at the time of the water level measurement.
16. Pumping Rate (gal/min) -- Flow rate of pump measured from an orifice, weir, flow meter,

container or other type of water-measuring device.

Test Duration

The duration of the test is determined by the needs of the project and properties of the aquifer. One simple test for determining adequacy of data is when the log-time versus drawdown for the most distant observation well begins to plot as a straight line on the semilogarithmic graph paper. There are several exceptions to this simple rule of thumb, therefore, it should be considered a minimum criterion. Different hydrogeologic conditions can produce straight line trends on log-time versus drawdown plots. In general, longer tests produce more definitive results. A duration of 1 to 3 days is desirable, followed by a similar period of monitoring the recovery of the water level. Unconfined aquifers and partially penetrating wells may have shorter test durations. Knowledge of the local hydrogeology, combined with a clear understanding of the overall project objectives, is necessary in interpreting just how long the test should be conducted. There is no need to continue the test if the water level becomes constant with time. This normally indicates that a hydrogeologic source has been intercepted and that additional useful information will not be collected by continued pumping.

7.7.6 Post Operation

1. After completion of water level recovery measurements, decontaminate and/or dispose of equipment as per ERT SOP #2006, Sampling Equipment Decontamination.
2. When using an electronic data-logger, use the following procedures.
 - ⌘ Stop logging sequence.
 - ⌘ Print data, or save memory and disconnect battery at the end of the day's activities.
3. Replace testing equipment in storage containers.
4. Check sampling equipment and supplies. Repair or replace all broken or damaged equipment.
5. Review field forms for completeness.

APPENDIX B

HNU Field Protocol

HNU Field Protocol SOP #2149

Startup Procedure

1. Before attaching the probe, check the function switch on the control panel to ensure that it is in the 'off position'. Attach the probe by plugging it into the interface on the top of the readout module. Use care in aligning the prongs in the probe cord with the plug in; do not force.
2. Turn the function switch to the battery check position. The needle on the meter should read within or above the green area on the scale. If not, recharge the battery. If the red indicator light comes on, the battery needs recharging.
3. Turn the function switch to any range setting. For no more than 2 to 3 seconds look into the end of the probe to see if the lamp is on. If it is on, you will see a purple glow. Do not stare into the probe any longer than three seconds. Long term exposure to UV light can damage eyes. Also, listen for the hum of the fan motor.
4. To zero the instrument, turn the function switch to the standby position and rotate the zero adjustment until the meter reads zero. A calibration gas is not needed since this is an electronic zero adjustment. If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted, if necessary. Wait 15 to 20 seconds to ensure that the zero reading is stable. If necessary, readjust the zero.
2. Set the function switch to the range setting for the concentration of the calibration gas.
3. Attach a regulator (HNU 101-351) to a disposable cylinder of isobutylene gas. Connect the regulator to the probe of the HNU with a piece of clean Tygon tubing. Turn the valve on the regulator to the 'on' position.
4. After 15 seconds, adjust the span dial until the meter reading equals the concentration of the calibration gas used. The calibration gas is usually 100 ppm of isobutylene in zero air. The cylinders are marked in benzene equivalents for the 10.2 eV probe (approximately 55 ppm benzene equivalent) and for the 11.7 eV probe (approximately 65 ppm benzene equivalent). Be careful to unlock the span dial before adjusting it. If the span has to be set below 3.0 calibration, the lamp and ion chamber should be inspected and cleaned as appropriate. For cleaning of the 11.7 eV probe, only use an electronic-grade, oil-free freon or similar water-free, grease-free solvent.
5. Record in the field log: the instrument ID # (EPA decal or serial number if the instrument is a rental); the initial and final span settings; the date and time; concentration and type of calibration used; and the name of the person who calibrated the instrument.

Operational Check

1. Follow the startup procedure.
2. With the instrument set on the 0-20 range, hold a solvent-based Magic Marker near the probe tip. If the meter deflects upscale, the instrument is working.

Field Calibration Procedure

1. Follow the startup procedure and the operational check.
4. When the activity is completed or at the end of the day, carefully clean the outside of the HNU with a damp disposable towel to remove any

Operation

1. Follow the startup procedure, operational check, and calibration check.
2. Set the function switch to the appropriate range. If the concentration of gases or vapors is unknown, set the function switch to the 0-20 ppm range. Adjust it if necessary.
3. While taking care not to permit the HNU to be exposed to excessive moisture, dirt, or contamination, monitor the work activity as specified in the site health and safety plan.

visible dirt. Return the HNU to a secure area and place on charge.

5. With the exception of the probe's inlet and exhaust, the HNU can be wrapped in clear

plastic to prevent it from becoming contaminated and to prevent water from getting inside in the event of precipitation.

APPENDIX C

Forms

Well Completion Form

SOP #2150

PAGE-OF-

MONITOR WELL INSTALLATION			
Client: _____		Job No.: _____	
Date Drilled: _____		Well No.1 _____	
Site: _____		Elevation Pad _____	
Top of Steel Casing: _____		Total Depth: _____	
Casing Size & Type: _____		Screen Size: _____	
Comments: _____			
Depth	Symbol Stratigraphy	Sample Description	Completion Data

Groundwater Level Data Form

SOP #2151

PAGE-OF-

[illegible]

Pump/Recovery Test Data Sheet

SOP #2157

PAGE-OF-

[illegible]

Pump/Recovery Test Data Sheet (Continued)

SOP #2157

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Slug Test Data Form

SOP #2158

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APPENDIX D

LABORATORY ANALYTE LIST AND REPORTING LIMITS

Summit Environmental Technologies

MDL Data

MDL's listed are for water, soil, sediment and biota

Analyte	Method	MDL	Units	mg/Kg
Cd	6010/200.7	0.82	ug/L	0.02
Cr	6010/200.7	1.09	ug/L	0.05
Ba	6010/200.7	0.57	ug/L	0.03
As	6010/200.7	2.06	ug/L	0.19
Cu	6010/200.7	1.83	ug/L	0.08
Zn	6010/200.7	0.53	ug/L	0.08
Ni	6010/200.7	1.16	ug/L	0.07
Tl	6010/200.7	5.29	ug/L	0.16
Be	6010/200.7	0.72	ug/L	0.08
Pb	6010/200.7	2.1	ug/L	0.45
Se	6010/200.7	4.49	ug/L	0.1
Sb	6010/200.7	2.37	ug/L	0.08
Ca	6010/200.7	3.93	ug/L	0.68
Mg	6010/200.7	0.79	ug/L	0.52
Mn	6010/200.7	0.43	ug/L	0.06
Co	6010/200.7	0.51	ug/L	0.06
Fe	6010/200.7	10.56	ug/L	0.64
Al	6010/200.7	10.53	ug/L	4.38
V	6010/200.7	1.74	ug/L	0.05
Mo	6010/200.7	2.87	ug/L	0.1
Ti	6010/200.7	1.49	ug/L	0.06
Ag	6010/200.7	0.39	ug/L	0.04
B	6010/200.7	0.82	ug/L	0.31
K	6010/200.7	23.99	ug/L	7.24
Na	6010/200.7	197.41	ug/L	43.49
Si	6010/200.7	2.97	ug/L	1.53
Sn	6010/200.7	37.69	ug/L	0.87
P	6010/200.7	17.35	ug/L	1.1

Analyte	Method	MDL	Units	
Low Level Hg	1631	0.5	ng/L	N/A

Analyte	Method	MDL	Units	
Fluoride	300.0/9056	0.08	mg/L	0.08
Chloride	300.0/9056	0.03	mg/L	0.03
Nitrite	300.0/9056	0.03	mg/L	0.03
Bromide	300.0/9056	0.04	mg/L	0.04
Nitrate	300.0/9056	0.03	mg/L	0.03
Phosphate	300.0/9056	0.11	mg/L	0.11
Sulfate	300.0/9056	0.09	mg/L	0.07

Analysis	Water MDC (pCi/L)	Solid MDC (pCi/g)
Isotopic Uranium		
U-234	0.06	0.1
U-235	0.06	0.1
U-236	0.06	0.1
U-236	0.06	0.1
Gamma Spectroscopy (example isotopes)		
Ba-133	4.0	0.12
Bi-211	14.2	0.08
Bi-212	52.4	0.19
Bi-214	63.5	0.18
Cd-109	46.2	0.24
Co-57	6.9	0.04
Co-60	3.5	0.01
Cs-134	4.1	0.02
Cs-137	3.7	0.02
Eu-152	9.7	0.04
Eu-154	4.1	0.02
Eu-155	6.2	0.03
I-129	6.6	0.04
I-131	4.8	0.10
K-40	23.7	0.09
Mn-54	4.1	0.01
Na-22	3.8	0.02
Pb-210	55.9	0.23
Pb-212	4.2	0.02
Pb-214	4.7	0.03
Ra-226	48.3	0.3
Ra-228	11.5	0.01
Sc-46	3.8	0.02
Zn-65	9.5	0.09